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& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

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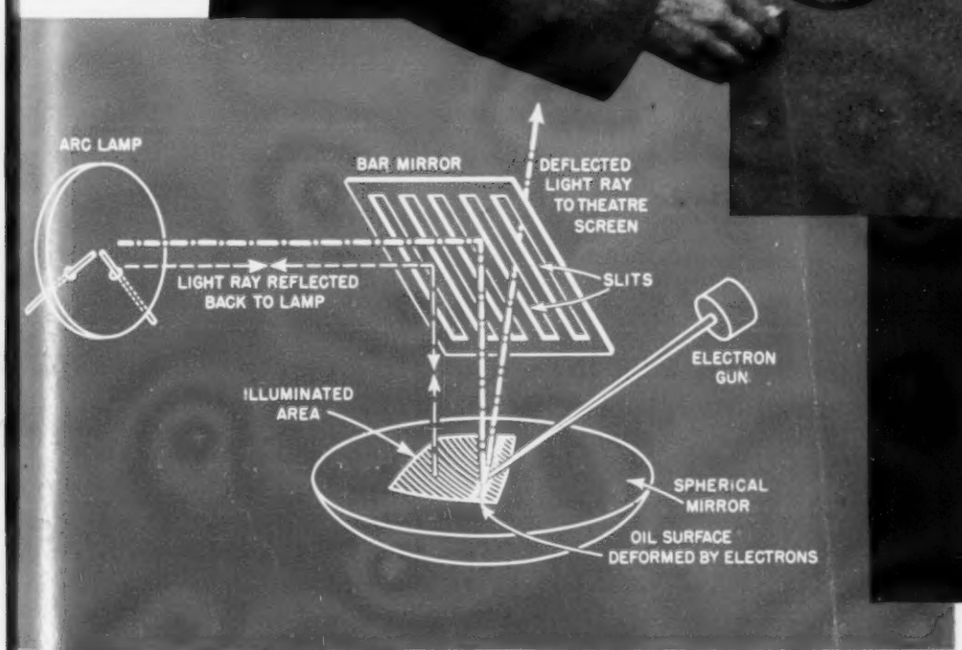

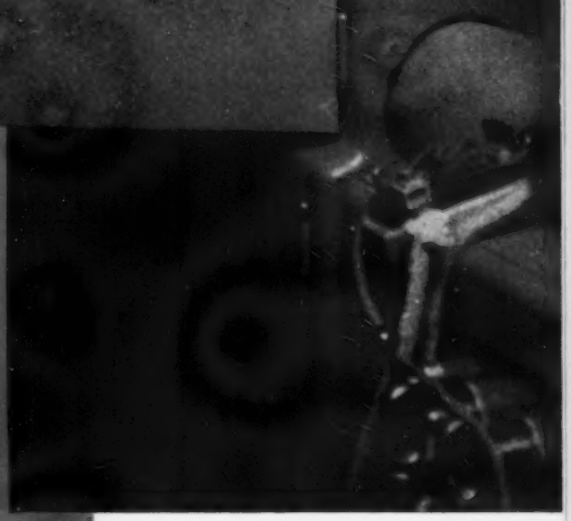

E. I. Sponable and S. P. Skouras of 20th Century Fox examine new Eidophor arc-operated theatre-TV projector. Sketch shows optical principle. See page 57

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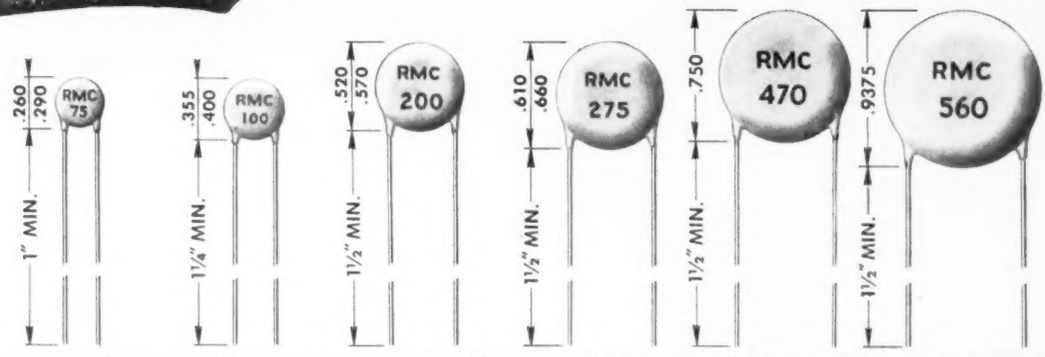

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NPO	2- 12 MMF	13- 27	28- 60	61- 75 MMF	76-110 MMF	111-150 MMF
N- 33	2- 15	16- 27	28- 60	61- 75	76-110	111-150
N- 80	2- 15	16- 27	28- 60	61- 75	76-110	111-150
N- 150	2- 15	16- 30	31- 60	61- 75	76-110	111-150
N- 220	2- 15	16- 30	31- 75	76-100	101-140	141-190
N- 330	2- 15	16- 30	31- 75	76-100	101-140	141-190
N- 470	2- 20	21- 40	41- 80	80-120	121-170	171-240
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RADIO-TELEVISION-ELECTRONIC INDUSTRIES

AUGUST, 1952

FRONT COVER: EIDOPHOR PROJECTOR FOR THEATRE COLOR TV is examined by Earl I. Sponable (1), Research Director of Twentieth Century-Fox, and President Spyros P. Skouras. Invented in Switzerland and developed by the film company, Eidophor produces large-screen color pictures of high brightness, excellent definition and good color fidelity, almost comparable with that of motion pictures. The device utilizes the CBS field-sequential color system. Eidophor's novel basic operating principle is illustrated in the diagram. Light from an arc source strikes a bar mirror, half of it passing through the parallel slits and being lost. The other half is reflected onto the oil surface of a spherical mirror. Light rays striking relatively undisturbed oil are reflected back to the bar mirror and lamp; rays impinging on an oil area deformed by a TV camera-controlled electron gun are deflected to pass through the slits to the theatre screen. See page 57.

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y's first Tubular-
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them)

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Many members have made electronic history!

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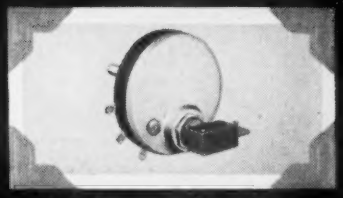
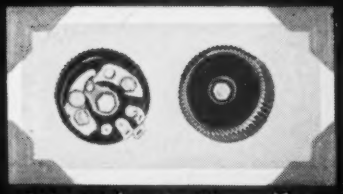
Variable Resistors

(Great grandad)

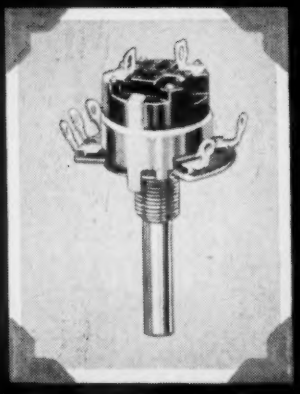
1922 First composition variable resistor ever built



1929 First combination variable resistor and switch



1946 Model 1 - World's smallest switch type variable resistor



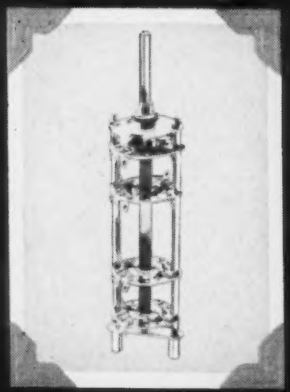
1949 Model 2 Radiohm the most modern high quality variable resistor

(Latest addition to this part of the family)

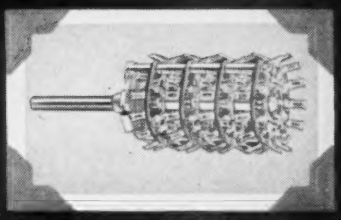
1951 New High Torque Variable Resistor - world's smallest - no bigger than a dime!

Switches

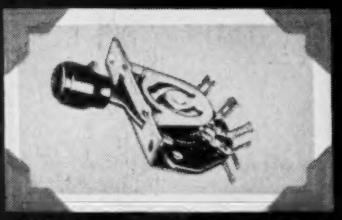
(She started this branch of the family)



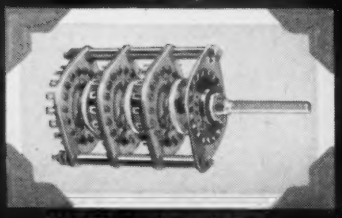
1936 A new and complete line of wave band switches



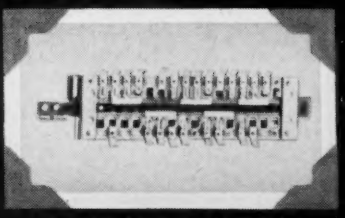
1938 The industry's first 24 contact per single section switch



1939 First multiple contact lever action switch

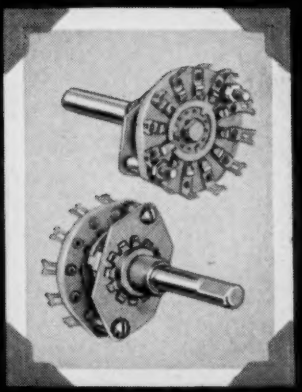


1943 The industry's first low-loss, high frequency medium duty power switch



1947 The first slide switch introduced to the industry

(our most beautiful babies!)

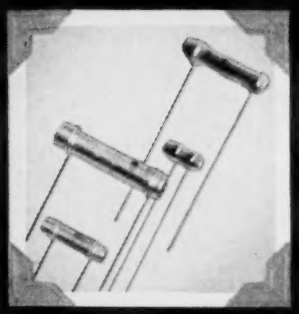


1951 New miniature rotary switch (1 7/16" dia.)

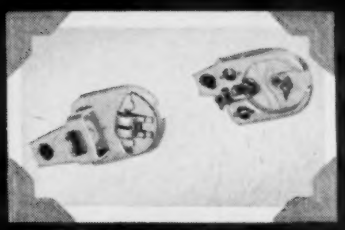
HAS BEEN GROWING FOR 30 YEARS

Capacitors

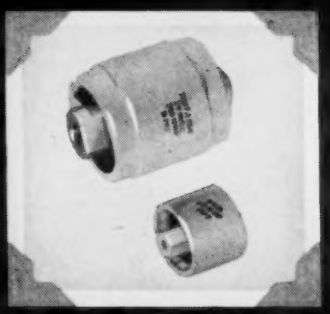
(War babies who made more than good in peacetime)



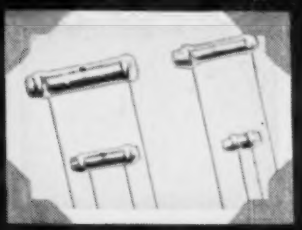
1936 Temperature Compensating Ceramic Capacitors



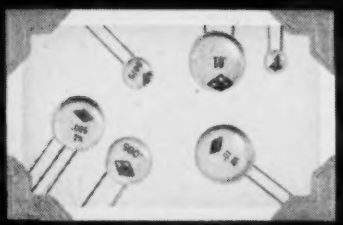
1939 Industry's first Ceramic Trimmer Capacitors



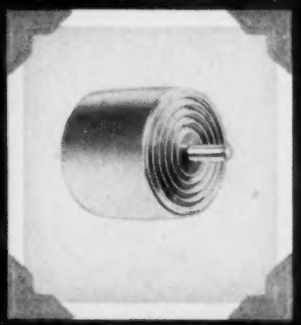
1941 Industry's first High Voltage Transmitting Ceramic Capacitors



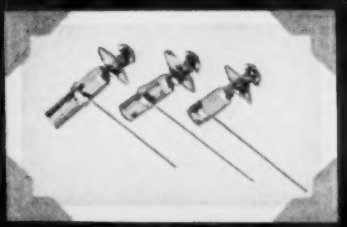
1945 Industry's first Tubular-Type, By-Pass coupling Ceramic Capacitors —



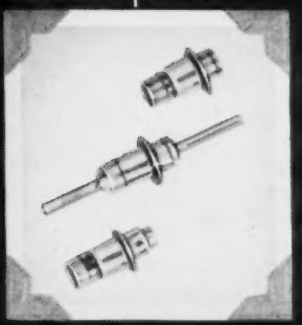
1946 The first Disc-Type By-Pass coupling ceramic Capacitors introduced to the electronic industry



1947 Industry's first TV High Voltage Ceramic Capacitors

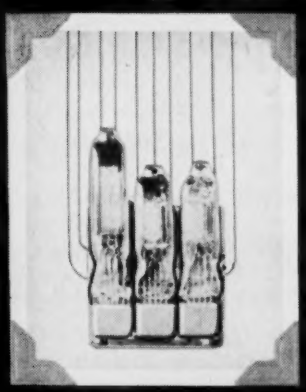


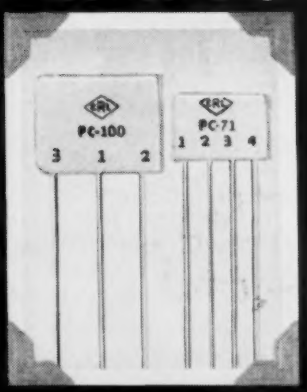
1949 Industry's first Ceramic Tubular Trimmer Capacitors

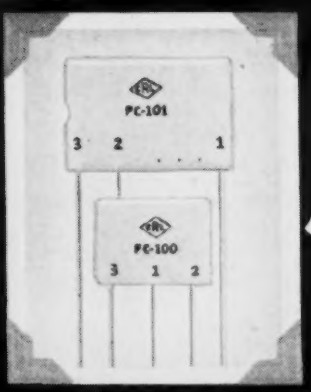


1951 New Eyelet-Mounted Feed-Through Ceramic Capacitors

Printed Electronic Circuits



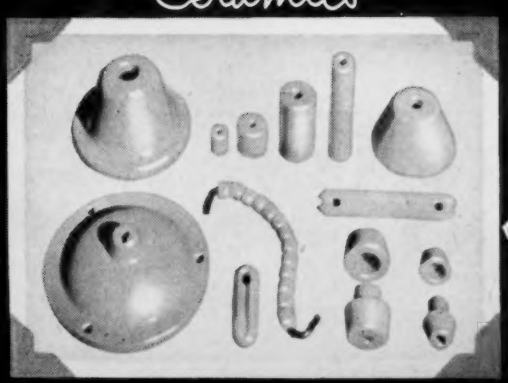




(Nobody ever saw anything like these, but now everybody wants them)

1943 Centralab originated the industry's first printed ELECTRONIC circuit

Ceramics



1942 First offered fine ceramics to industry. Actually, Centralab had been making ceramics for its own use since 1928 . . . but in 1942 developed a grade L-5 Steatite Ceramic superior to the then existing Navy grade "G" specification

Centralab was the first to metalize ceramics. By 1945 Cordierite and Zirconite bodies with grade L-4 rating were developed.

(This branch of the family just grows and grows and grows and there's no room for all their pictures)

Centralab

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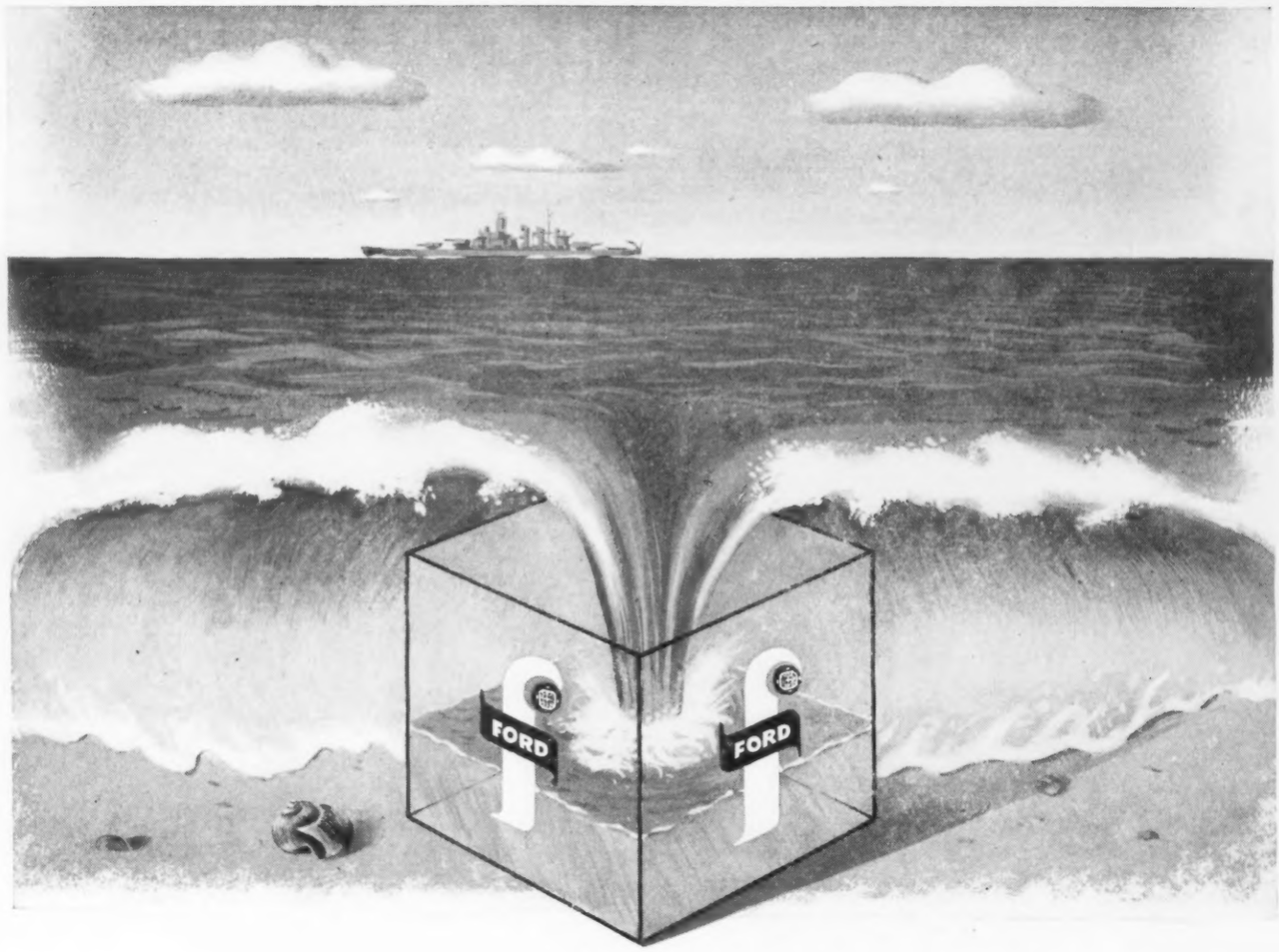

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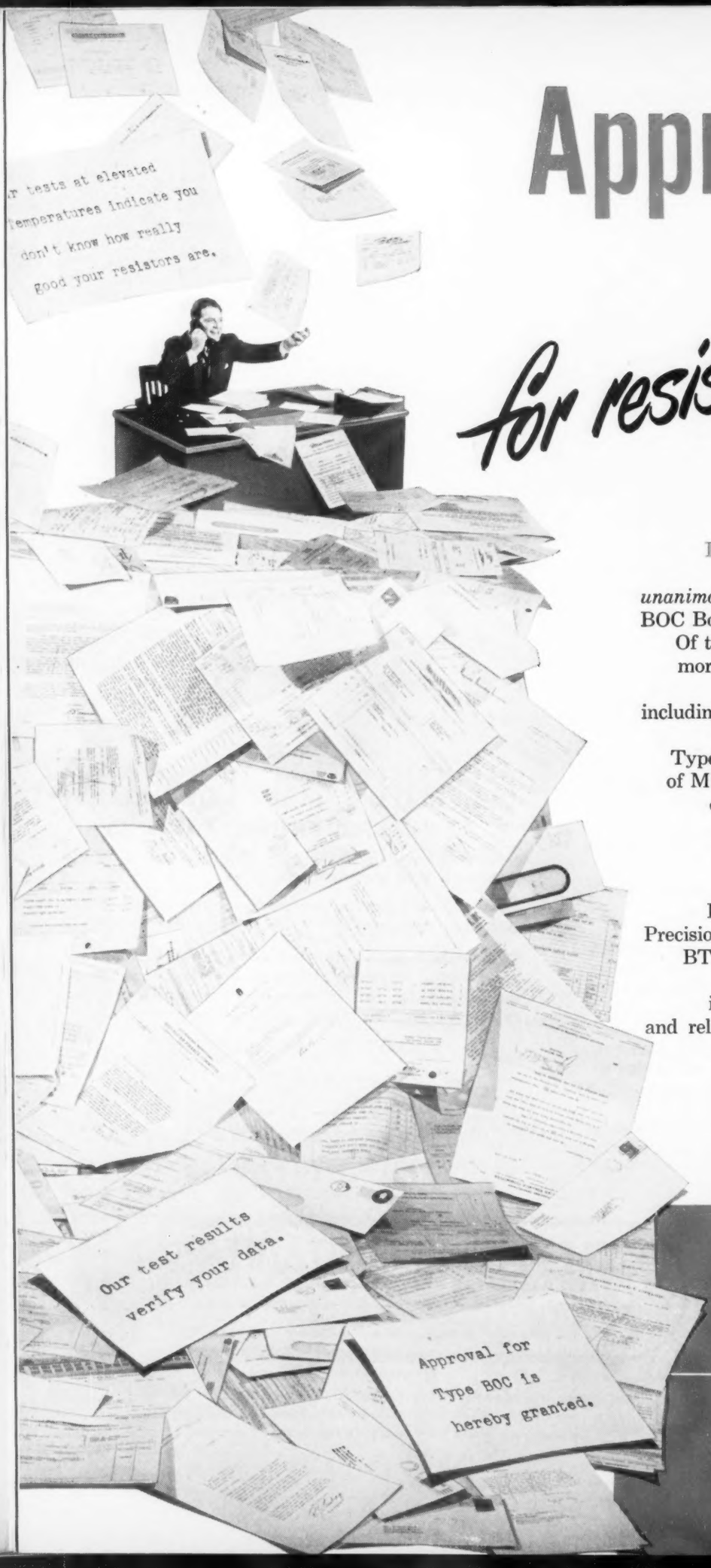
Approval is

for resistors too!



In all our experience, no resistor has been so extensively tested—*and so unanimously approved*—as IRC's new Type BOC Boron-Carbon ½-watt PRECISTOR. Of the 3,000,000 already manufactured, more than 100,000 were given the most stringent tests-in-production, including critical temperature cycling and 500-hour load-life tests. Result:—Type BOC conforms to *all* requirements of MIL-R-10509A! Also, customers have conducted their own laboratory and field tests—and they express their approval of Type BOC in letters like those shown here.

In the case of IRC's new JAN Type Precision Wire Wounds and Advanced Type BT Resistors, too, rigid quality control and continued testing have won industry-wide approval. Most stable and reliable of all precision wire wounds, Type WW's far surpass JAN-R-93 Characteristic B Specifications. And Type BT's continue to meet and beat JAN-R-11 Specifications.

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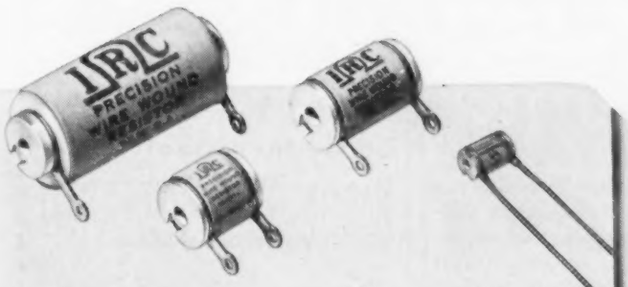
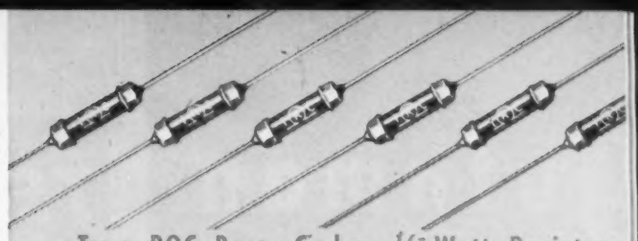


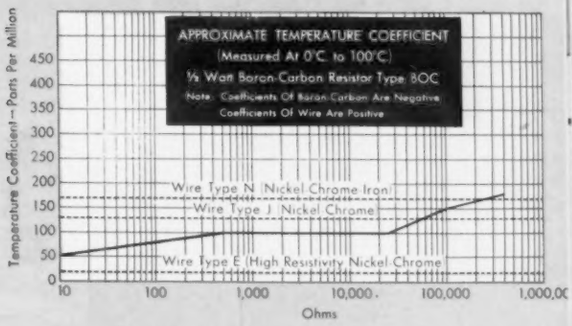
New JAN Type Precision Wire Wound Resistors Excel JAN-R-93 Characteristic B Specifications

	Original Resist	1st Cycle % Chge	2nd Cycle % Chge	3rd Cycle % Chge	4th Cycle % Chge	Resist at End of 100 hrs load	Total % Chge	% Chge from Last Temp Cycle to End of 100 hrs load %	Resistance Chge at End of 100 Hrs Load only % (no cycling)
1	100.010	+ 04	+ 04	+ 05	+ 05	100.050	+ 04	— 01	100.040 — 02
2	100.000	+ 03	+ 04	+ 03	+ 05	100.060	+ 06	+ 01	100.000 0
3	100.000	+ 01	+ 02	+ 02	+ 05	100.000	0	+ 05	100.050 — 02
4	100.000	+ 02	0	+ 02	+ 02	100.000	0	— 02	100.040 — 01
5	100.010	+ 03	+ 04	+ 04	+ 05	100.000	0	— 05	100.030 — 03
6	100.000	0	+ 03	+ 04	+ 04	100.100	+ 1	+ 06	99.980 0
7	100.000	+ 04	+ 05	+ 04	+ 04	100.070	+ 07	+ 03	100.000 0
8	100.000	+ 03	+ 05	+ 05	+ 05	100.050	+ 05	0	100.000 0
9	100.000	+ 04	+ 03	+ 05	+ 04	100.010	+ 01	— 03	100.050 0
10	100.000	+ 02	+ 02	+ 02	+ 04	100.010	+ 01	— 03	100.000 0
11	100.000	0	+ 01	+ 01	+ 03	100.000	0	— 03	

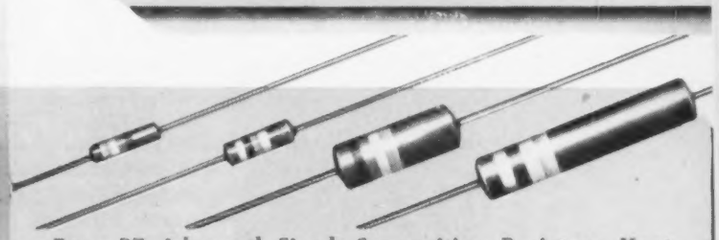
Most *reliable and stable* of all wire-wound precisions, these new Type WW's have proved their superiority in unbiased tests. Severe cycling and 100-hour load tests resulted in virtually zero changes in resistance. Other stringent tests proved JAN Type WW's high mechanical strength, freedom from shorting, resistance to high humidity. New winding forms—new winding technique—new type insulation—and new terminations assure long life, accuracy, ruggedness in service. IRC JAN Type WW's are becoming the choice of leading producers of military equipment. Get full technical data in Catalog Bulletin D-3.



Type BOC Boron-Carbon ½-Watt Resistor Surpasses Signal Corps Specification MIL-R-10509A



The ultimate in *stable, reliable* non-wire-wound resistors, Type BOC's are especially designed for military electronic equipment—radar, gunnery control, communications, telemetering, computing and service instruments. Greatly improved temperature coefficients of resistance permit their use in place of costlier wire wound precisions in many critical applications. Lower capacitive and inductive reactance suit them to circuits where wire-wound stability is needed. Small size makes them ideal in limited space. *Tolerance:*—1%, 2% and 5%. *Resistance Values:*—10 ohms to ½ megohm. Send for full technical data in Catalog Bulletin B-6.



Type BT Advanced Fixed Composition Resistors Meet and Beat JAN-R-11 Specifications

Type BTS Meets and Beats Rigid G Characteristic

These are the famous Advanced Type BT's whose characteristics set new performance records for fixed composition resistors. They combine a unique filament-type resistance element with exclusive construction features to assure extremely low operating temperature and excellent power dissipation. Yet they are compact, light in weight, fully insulated. Intensive tests by independent agencies have proved their superiority under actual field conditions. For full technical data, send for Catalog Bulletin B-1.

Mail Coupon Today for Full Details of These IRC Resistors

Boron-Carbon PRECISTORS • Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Volume Controls • Voltage Dividers • Precision Wire Wounds • Deposited Carbon PRECISTORS • Ultra HF and High-Voltage Resistors • Insulated Chokes • Selenium Rectifiers

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- ☐ Type BOC Boron-Carbon PRECISTORS
- ☐ Type WW Precision Wire Wound Resistors
- ☐ Type BT Advanced Fixed Composition Resistors
- ☐ Name and Address of Nearest IRC Distributor

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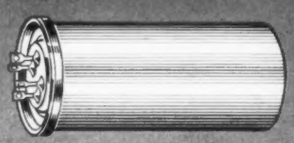
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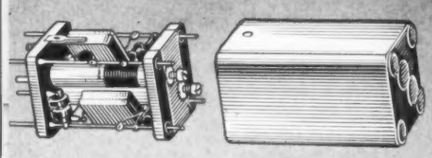

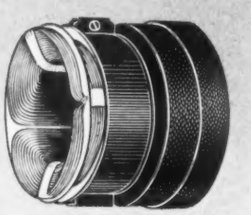
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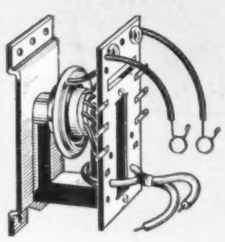
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TELE-TIPS

SIXTH STATION—Television station WATV, Newark, N. J., will move its transmitter and antenna to the top of the Empire State Building, New York City. Its studios will remain in Newark. WATV will be the sixth television station to make use of the Empire State Building's 222-foot steel tower, which was completed and put into operation last year. The only New York station not using the site will be WOR-TV, which has its own antenna tower in North Bergen, N. J. With the addition of the new tenant, the Empire State Building will realize approximately $600,000 annually from television rentals. Each station pays $70,000 a year for antenna space on the tower plus $7 a square foot for transmitter space.

PSYCHOLOGICAL SUCCESS?—In an effort to collect television license fees for an estimated 250,000 unlicensed receivers, the British Post Office has developed a detector van which is reputed to be able to detect an "illegal" TV receiver by reception of the second harmonic of horizontal scanning frequency at distances up to 100 yards. Three frame antennas placed in an easily seen position on top of a truck are tuned to 20.25 kc (British standards) By triangulation from these antennas, it is said that a receiver can be located as closely as the room or floor in a house. We wonder whether the psychological effect of the "detector van," plus a few lucky guesses, does not play a large part in the success of this operation!

NOISES IN THE NIGHT were recently experienced by an engineer who thought he heard his garage door opening. He got there in time to see it closing! Since it operated by radio control from his car he was curious in case he had a burglar, so he went to fetch his shotgun. On his return he found the doors open! He hid and observed what went on. In two hours time he found that every time one of the electric locomotives which operated on the line nearby, passed his house, interference from it operated the doors. Changing his system to FM instead of AM cured the trouble.

(*Continued on page* 15)

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General Electric offers you Expanded Application Engineering Service

HERE'S a way to improve the design of your radio-phonograph products and beat rising costs—without increasing your overhead.

The extensive research and engineering facilities of Electronics Park are yours to call upon for consultation or help in the following fields:

CARTRIDGES AND STYLI—G-E single and dual units, diamond or sapphire*-tipped for every recording or broadcast application, can be suited to your product requirements. The startlingly different G-E "Golden Treasure" cartridge, now in quantity production, features a dual wide-range diamond and sapphire stylus that reproduces an exceptional tone range of 30 to 15,000 cycles. Stylus pressure for *all* types of records is low—only 6 to 8 grams.

LOUDSPEAKERS—Choose from 19 G-E types sized from 4 to 12 inches. These include 6 sizes of round speakers, plus a special 6 x 9 oval for auto radio use. Remember too, that *the G-E 1201 and 1203 are the only high fidelity speakers commercially available in production quantities at moderate prices.* Of course, all G-E speakers have Alnico 5 magnets and the aluminum voice coil.

Our application engineers are prepared to discuss with your designers ways in which G. E. can be of service to you. Just phone or wire us. Meanwhile, check the coupon below for latest catalogs listing audio components.

*Some sapphires are synthetic.

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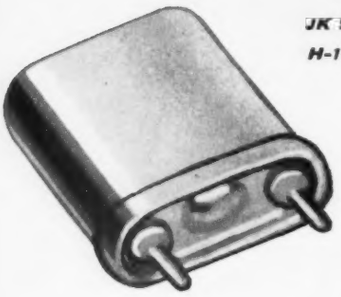
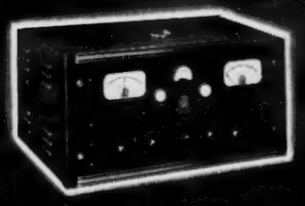
JK STABILIZED H-17 CRYSTAL



CRYSTALS FOR THE CRITICAL

The small, compact H-17 is designated as a military type crystal for its use in mobile units common to the military. Frequency range: 200 kc to 100 mc. Hermetically sealed holders; wire-mounted, silver-plated crystals.

the JK FD-12



FREQUENCY AND MONITOR MODULATION

Monitors any four frequencies anywhere between 25 mc and 175 mc, checking both frequency deviation and amount of modulation. Keeps the "beam" on allocation; guarantees more solid coverage, too!

"High Gear" Response to High Power Maintenance!

Dawn or dusk, it doesn't matter. These heroes of the high wires arrive to stop power trouble before it starts. Their "nose for disaster" is in the service truck, in the mobile radio unit which often relies on JK crystals and monitors to keep their assigned radio frequency on the beam!

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For complete information on Astron METALITE and other standard capacitors, write for Catalog AC-3.

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Radio-relay station at Evanston, Wyoming

a Watcher for lonesome places

Many of the Bell System's 107 radio stations connecting New York and San Francisco by microwave radio-relay stand on hills and mountains far from towns. Day after day, the apparatus does its duty; no man need be there to watch it. But when trouble threatens, an alarm system developed by Bell Telephone Laboratories alerts a testman in a town perhaps a hundred miles away.

A bell rings. The testman sends a signal which asks what is wrong. A pattern of lights gives the answer —a power interruption, an overheated tube, a blown fuse, a drop in pressure of the dry air which keeps moisture out of the waveguide. At intervals the testman puts the system through its paces to be sure it is on guard.

Sometimes the testman can correct a trouble condition through remote control, or the station may cure itself—for example, by switching in an emergency power supply. Sometimes the trouble can await the next visit of a maintenance man—sometimes he is dispatched at once.

This is one of the newest examples of the way Bell Laboratories adds value to your telephone system by reducing maintenance costs and increasing reliability.

Alarm-receiving bay in town. Lights on a chart report on 42 separate conditions affecting service. Telephone is to communicate with maintenance crews. Eleven alarm centers across the country cover all 107 radio-relay stations. Stations too far off the beaten trail for wire connections signal by very high frequency radio.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS.

TELE-TIPS

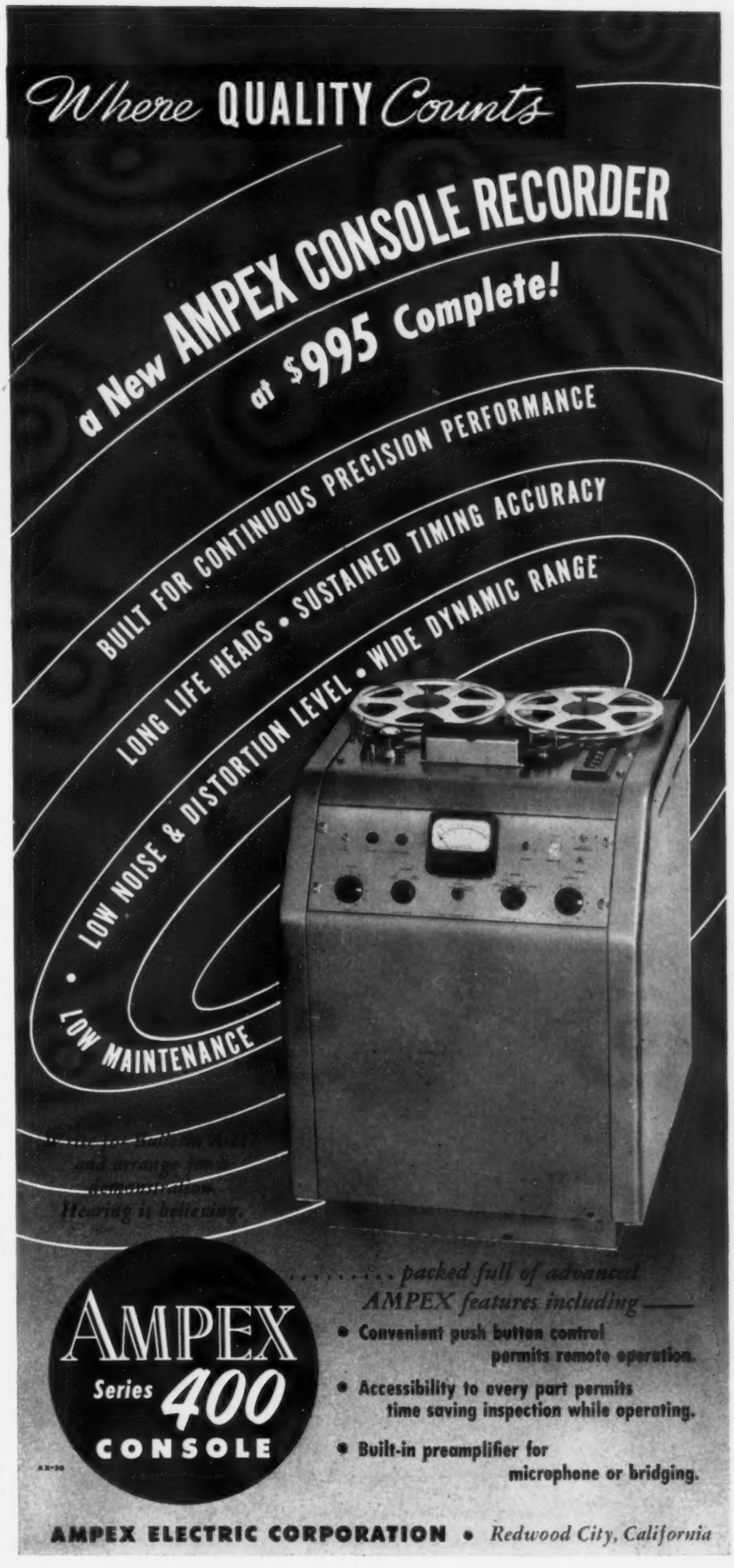
(*Continued from page* 10)

TRANSPARENT PHOSPHOR screens, having greater contrast and sharpness than conventional powdered phosphor screens used in TV picture tubes, are being developed by General Electric Co. These screens, which eliminate the overall haze caused by light scattering in powdered types, are laid on the glass backing plate by a chemical process involving the reactions of vapors at the surface. Limited brightness is still an obstacle to be overcome.

GROUP ANTENNAS—The subject of video distribution has come up again—this time in the Netherlands. The new Netherlands television station at Lopik will have an ERP of 100 KW operating in the VHF band. In order to provide adequate signal strength in the larger towns in the "fringe" areas of this station, it is proposed to use receiving antennas mounted in good locations each feeding a video distribution system similar to those already used in this country.

RECENT SPEECH experiments, in which a talker read lists of words through an electronic speech-transmission circuit to a group of listeners wearing headphones, showed how difficult it is entirely to destroy speech intelligibility. Although the investigation did not correlate the intelligibility of the male and female voice, there was wide speculation that the latter is both indestructible and unintelligible. One of the distorting devices inserted in the speech-transmission circuit eliminated every trace of the speech wave except markers of the instants at which the speech wave vanished. With this device in the circuit, the listeners recorded 90% of the talker's words correctly. Another device eliminated the top half of the speech wave and let the listener hear only the bottom half. With this device in the circuit, intelligibility was almost perfect. Still other devices performed simple mathematical operations upon the speech wave, such as multiplying the sound pressure at each instant by itself or squaring the sound pressures. Using the squaring device, the listeners missed most of the test words, which were spoken out of context, but they could piece together enough of the conversation to understand the talker. At no time during the experiments was intelligibility completely destroyed by the distortion.

(*Continued on page* 20)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a New AMPEX CONSOLE RECORDER
at $995 Complete!
BUILT FOR CONTINUOUS PRECISION PERFORMANCE
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Lessons learned through experience, observation, and coordination with leading tower erectors during construction of hundreds of towers, are reflected in the design, detail, and safe and simple field assembly of all Truscon Steel Radio Towers.

Your phone call or letter to any convenient Truscon district office or to our home office in Youngstown, will bring you immediate, capable engineering assistance on your tower problems. Call or write today.

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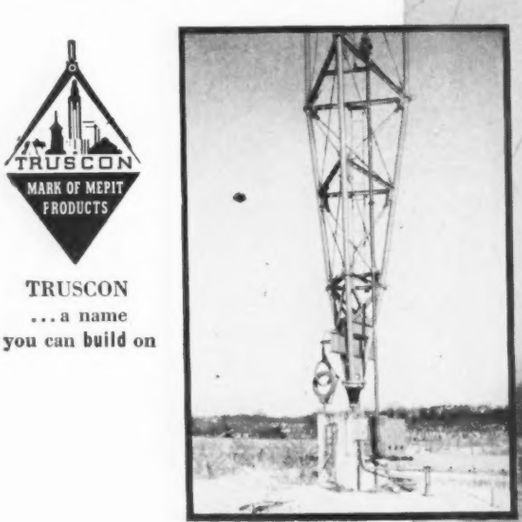

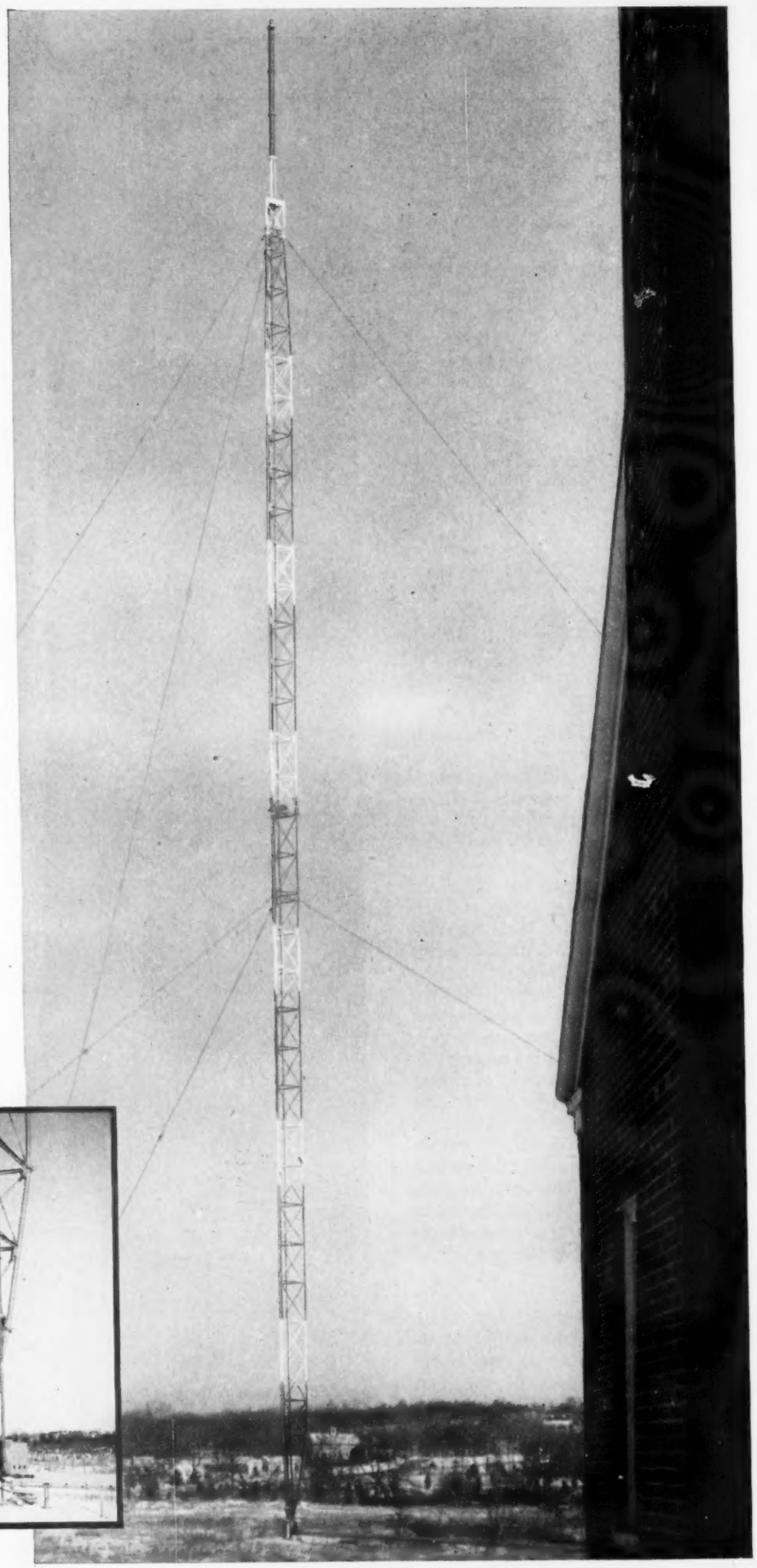

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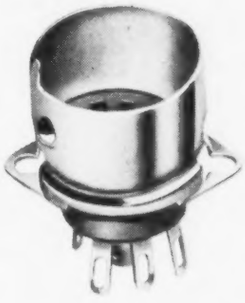
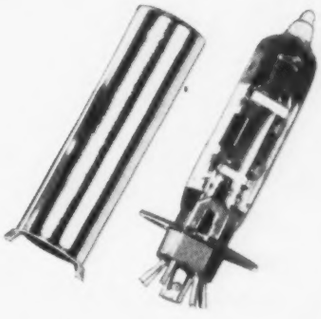


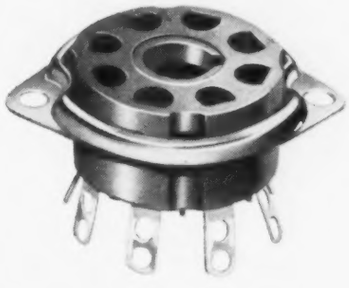
JAN OCTAL TUBE SOCKETS

Saddles of these sockets are nickel plated brass, either top or bottom mounted, with or without ground lugs. Body and contacts are of the same materials as the JAN miniature tube sockets. Contact tabs and saddle ground lugs are hot tin dipped.



JAN 7- AND 9-PIN MINIATURE TUBE SOCKETS

These sockets are available in grade L-4B or better ceramic, or type MFE low loss plastic. The contacts are either phosphor bronze or beryllium copper, silver plated. Contacts and center shield tab are hot tin dipped. Nickel plated brass shields equipped with sturdy springs are available for all 7- and 9-pin sockets.



BUTTON TYPE SUBMINIATURE (T3) TUBE SOCKETS

These sockets are available for round 8-pin subminiature tube types. Insulation is type MFE low loss plastic and contacts are beryllium copper silver plated with gold flash covering. Contacts especially designed for positive connection and high pin retention even after many insertions. Sockets are of rugged construction for long life.

When you order Sylvania Tube Sockets you get the extra value of Sylvania's experience and know-how at no extra cost. Designed for maximum strength and optimum electrical properties, Sylvania Sockets assure high tube retention and tube pin contact even under severe vibration. Highest quality is guaranteed by Sylvania's own exacting quality control.

For full information on the complete line of Sylvania Tube Sockets write: Sylvania Electric Products Inc., Dept. A-1108, Parts Sales Division, Warren, Pa.

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—built man-size for man-sized TV jobs!

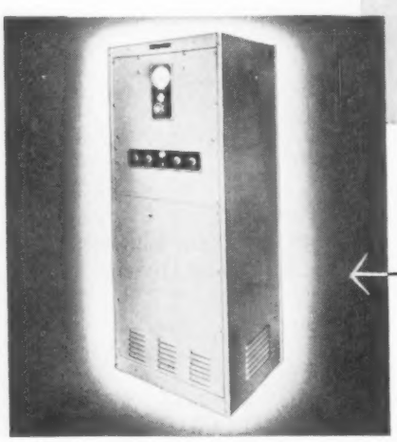
AUTO-DRYAIRE* DEHYDRATORS

MODEL 105-507

AUTO-DRYAIRE* DEHYDRATOR

SPECIFICATIONS:

- Fully automatic—dry air available without interruption. Capacity 3 CFM
- Dewpoints below —40° F.
- Floor model—26" W x 22" D x 66⅞" H
- Operating pressure adjustable up to 50 PSI
- Serves up to:
  40,000 ft 1⅝" Transmission Line.
  10,000 ft. 3⅛" Transmission Line.
  3,500 ft. 6⅛" Transmission Line.



MODEL 105-507 is fully automatic—this particular unit delivers 3 CFM. There are many others in the complete family of Auto-Dryaire* Dehydrators having characteristics to meet all requirements—standard models with deliveries from .15 CFM to 3.0 CFM; larger capacities to specifications.

For performance plus, specify the following products of our manufacture: SEAL-O-FLANGE* TRANSMISSION LINE, AM, FM and TV TOWER HARDWARE, LO-LOSS SWITCHES, and COAXIAL DIPOLE ANTENNAS. Inquiries invited.

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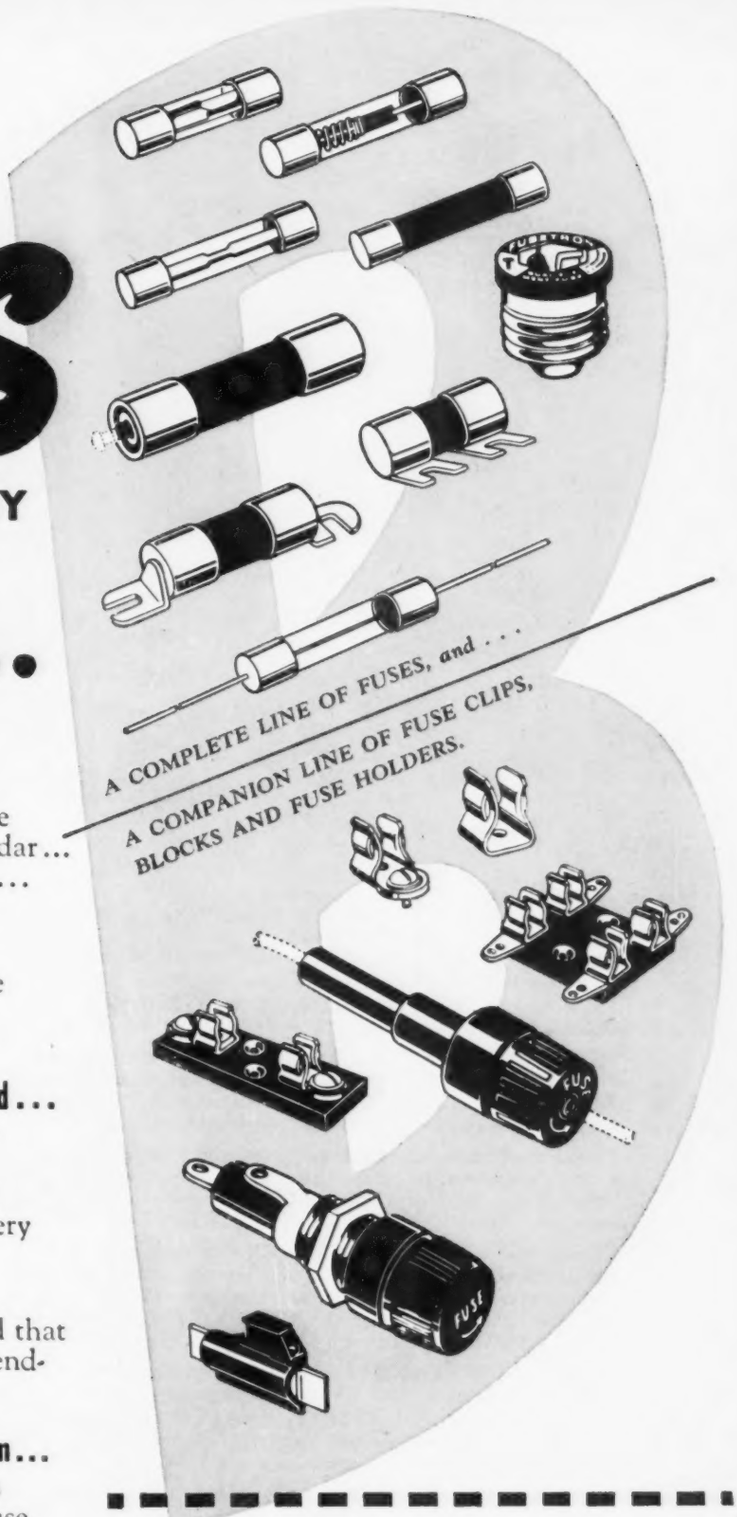
From 1/500 Amp. Up



BUSS offers the most complete line of fuses for Television...Radio...Radar... Instruments...Controls...Avionics... in standard types and dual-element (slow blowing) types.

By using BUSS as your one source for fuses you simplify your buying, stock handling and records.

Every BUSS Fuse is Electronically Tested... in a sensitive device that rejects any fuse that is not correctly calibrated, properly constructed and right in all physical dimensions. This means every BUSS Fuse is a good one.

Manufacturers and servicemen throughout the country have learned that they can rely on BUSS fuses for dependable protection.

If You Have a Special Protection Problem... let a BUSS engineer help you. He has at his command the world's largest fuse research laboratory and the world's largest fuse production capacity.

Send the Coupon
FOR MORE FACTS...

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BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me bulletin SFB containing complete facts on BUSS small dimension fuses and fuse holders.

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FOR AIRBORNE ELECTRONIC EQUIPMENT

When you require a Unit Type Mounting Base, send your equipment FIRST CLASS. Install it on a Robinson #831 Series Base — the *stock item* that always delivers dependable vibration isolation and shock protection.

Robinson All-Metal construction eliminates the customary limitations inherent in all organic materials. Performance remains constant and unvarying — regardless of altitude, temperature, climate, or period of service.

These Bases maintain a constant natural frequency of 550 cpm or less throughout the widest load range. Axial-lateral stiffness ratios are such as to provide maximum vibration isolation in all modes.

Robinson's exclusive MET-L-FLEX knitted wire resilient elements have the high damping and non-linear load deflection characteristics necessary for the safe absorption of shocks due to rough air, emergency landings, gunfire, or combat maneuvers. Auxiliary All-Metal limiters are provided for temporary overloads.

Robinson Unit Type Mounting Bases are available in all standard JAN sizes, and conform throughout to specification JAN-C-172A. Robinson standard "Proof Tested" construction needs no "ruggedization" to meet the 30 "G" Drop Test requirements of AN-E-19.

If your equipment needs maximum protection, or presents an unusual mounting problem, inquire about Robinson's Engineered Mounting Systems. Their cost is often no greater than stock item Bases. Availability and delivery are excellent.

For further details, call your nearest Robinson Engineering Representative, or write for Bulletin SS-700.

ROBINSON AVIATION INC.
TETERBORO, NEW JERSEY
Vibration Control Engineers

IN TODAY'S AIRCRAFT—ROBINSON MET-L-FLEX MOUNTS

TELE-TIPS

(*Continued from page* 15)

RADAR AHEAD! A Marine combat photographer, T/Sgt. Paul F. Shaner, got a flashy reception as he stepped out of a jeep at a forward Marine ground control interceptor squadron in Korea. Invisible radar rays from air-scanning equipment touched off simultaneously 40 flashbulbs he was carrying in a shoulder bag.

RADIO is being used more and more in aeronautical navigation. The latest large scale use is the release of radiosondes from the floating weather stations in the North Atlantic to check the upper winds and pressures. Every six hours for a period of two weeks recently a radiosonde was released from a weather station and tracked by radar. Aircraft on regular flights also cooperated in making special reports. Thus "pressure pattern" flying, which entails flying along certain pressure areas, is being improved and extended. Use of this system of flying results in increased payloads and lower transportation charges.

MIGHTY MITE—Reporting from Washington, F. C. Othman, in N. Y. World-Telegram, tells of an engineer friend "whose job lately has been that of attending some of the incredibly dull hearings of the Federal Communications Commission.

"Everybody fidgets and also squirms at these protracted proceedings. Everybody, that is, but my favorite electronic engineer. He adjusts his hearing aid in his left ear and spends whole afternoons with a beatific smile on his lips, paying rapt attention, while the lawyers wrangle interminably about legal wave lengths.

"Hearing aid? My man's ears are perfect. He has in his shirt pocket a 12-tube radio set. This is about the size of a cigaret package; a wire leads from it to the speaker button in his ear. While the other people suffer, he listens to the ball game. If he has to be on hand in the mornings, he turns his attention to soap operas; says some of them are surprisingly interesting. More interesting, at least, than lawyers.

"He made his mighty-mite radio in the laboratories of his own employers, using in place of 12 vacuum tubes a dozen transitors. These are the magical chunks of germanium, each about the size of a match head and doing all the work of a glass tube 500 times as big."

RCA UHF-TV SWEEP GENERATORS

for design and production applications

RCA WR-40A UHF Sweep-Marker Generator

NOW—for the UHF development and design laboratory—the new RCA WR-40A combines sweep generator, marker, and calibrator facilities in one compact, practical unit. Its versatility is unmatched for testing UHF-TV tuners, converters, receivers, antennas, and transmission lines in the 470-870-Mc band.

CHECK THIS LIST of Important Features:

✓ Center frequency of sweep oscillator is variable from 470 Mc to 890 Mc. Operates on fundamental frequencies without harmonics or beat notes.

✓ Full 45-Mc sweep width available throughout the entire UHF band. "On" or "Off" blanking is included.

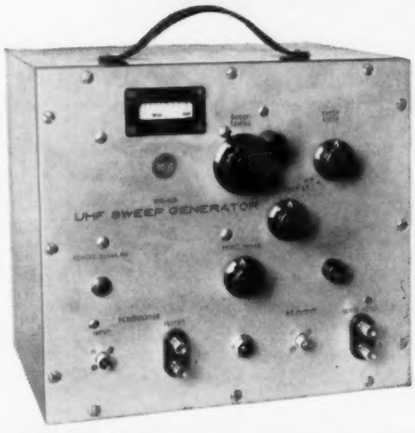
✓ Sweep generator output impedance is 50 ohms—output voltage across a 50-ohm resistive load is 0.5 volt. External pads to match 75-ohm and 300-ohm inputs are supplied.

✓ Amplitude variation of sweep oscillator does not exceed 0.1 db/Mc.

✓ Marker oscillator, controllable in amplitude, employs a hand-calibrated dial and operates on fundamental frequency throughout the UHF band.

✓ Crystal calibrator provides 1-Mc and 10-Mc check points throughout entire UHF band.

✓ Marker amplitudes from hand-calibrated variable oscillator and crystal calibrator remain constant over entire oscilloscope pattern.



RCA WR-41A UHF Sweep Generator

The WR-41A provides a quick, economical means of factory-testing UHF equipment with high accuracy. The instrument incorporates the same high-quality sweep oscillator as used in the WR-40A. Since this unit is designed primarily for production-line use, it employs four semi-fixed absorption-type markers. These are built inside the case, to prevent alteration of their adjustment during normal use.

For complete technical details and prices on the WR-40A and WR-41A UHF Sweep Generators, write RCA, Commercial Engineering, Section HR57, Harrison, N. J.

TMK.®

RADIO CORPORATION of AMERICA

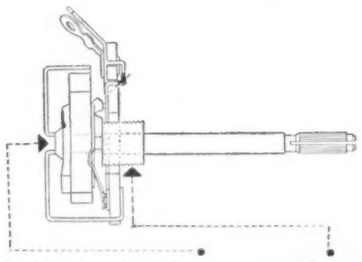
TEST EQUIPMENT **HARRISON, N. J.**

Small in size . . .

but big in features

. . . THE MALLORY MIDGETROL®

TWO-POINT SUSPENSION



holds the shaft here . . . and here

In all Mallory Midgetrols the control shaft is held firmly at *two* points instead of the usual one. The shaft simply can't wobble sideways, and won't move endways even when heavy pressure is exerted to force on the knob. This construction makes possible a shorter shaft bushing, and permits use of longer shafts.

Here's a carbon volume control that has all the features you need . . . for simplified design, faster production, top performance. Built for today's electronic equipment, Mallory Midgetrols offer you this unique combination:

SMALL SIZE: saves chassis space—outside diameter is only $^{15}/_{16}$", overall depth is only $^{33}/_{64}$".

WOBBLE-PROOF CONSTRUCTION: two-point suspension, patented by Mallory, holds shaft firmly, eliminates end and side play . . . prevents damage and uneven wear of the element when the shaft is turned or when heavy pressure is used to apply the knob.

QUIET OPERATION: exclusive Mallory sliding, silvered contact gives positive electrical connection without troublesome pigtail wiring.

STABILITY: unique manufacturing methods for applying and curing the resistance element assure constant resistance value even when exposed to extremes of humidity and temperature.

SMOOTH TAPER: a fine molecular carbon structure is deposited under precise control. Linear, right and left hand logarithmic tapers are available.

Midgetrols are supplied in a wide range of resistance values, and in styles for practically every standard or special application. For full details, write or phone Mallory today.

Television Tuners, Special Switches, Controls and Resistors

P.R. MALLORY & CO. Inc.

MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
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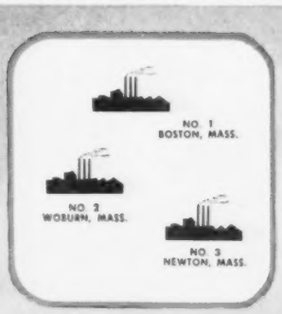
P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

STILL ANOTHER SYLVANIA ELECTRONIC TUBE PLANT



Second new plant in New England area to produce magnetrons and special purpose tubes

Again Sylvania prepares for new advances in electronics production with the announcement of plans for a third Electronics Division plant.

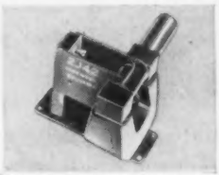
Located at Newton, Massachusetts, this up-to-the-minute manufacturing unit will include in-line-exhaust equipment devoted to manufacture of Sylvania Magnetrons for microwave radar equipment use.

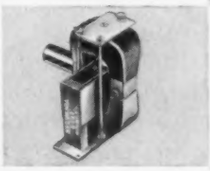
This new plant represents one more step in Sylvania's long-range program of providing high quality electronic tubes for military and commercial use where top performance is needed.

For information on Sylvania tubes for use from 1000 mc. up, write for Microwave Package H-4 which includes catalog material on Sylvania Magnetrons, TR and ATR Tubes, Hydrogen Thyratrons, Microwave Crystals, Rocket Tubes and Tunable Klystrons. Write Dept. E-2908, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

Sylvania Magnetrons

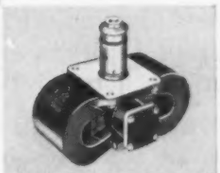
Type 2J42—A low-power fixed-frequency X-band type





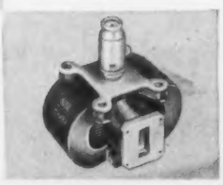
Type 6027—Similar to 2J42 with higher power output

Type 4J50—High-power X-band magnetron



Type 4J78—High-power X-band magnetron

Type 4J52—Low power X-band magnetron



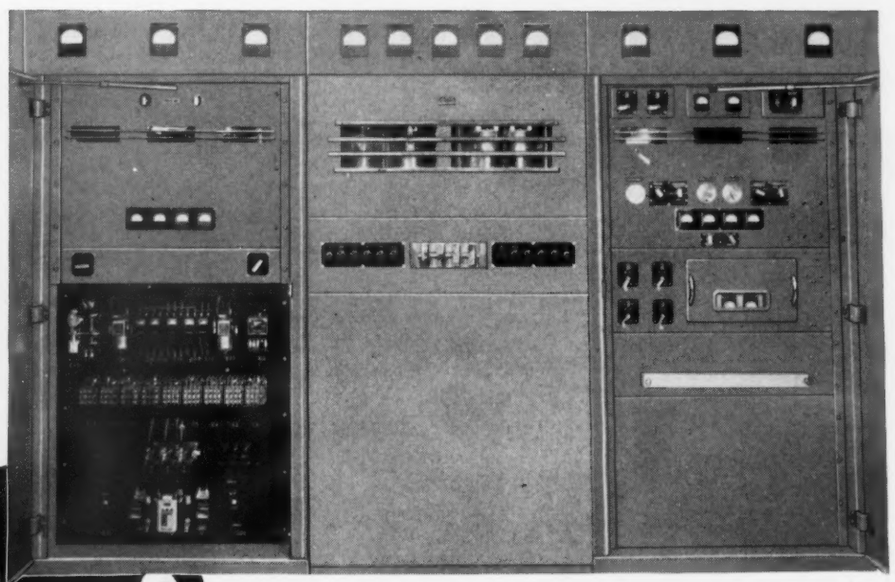
SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

GATES

10KW COMMUNICATIONS TRANSMITTERS...

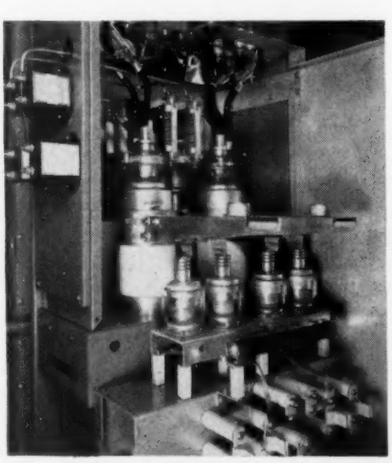
5



Models to Choose From

The popular GATES HF-10 High Frequency Transmitter is available in five different models for applications in broadcast, voice communications, high speed telegraphy or combinations of these services. These fine transmitters have gained world wide recognition for their complete reliability and excellence of signal quality. They are daily handling a sizeable quantity of the intercontinent communications between nations, both government and private.

High level Class B modulation is employed for all voice or broadcast models. The low plate voltage (5000 volts) assures reliability in line with high efficiency. Rated at 10 KW (telegraph) from 2-22 Mc. and 8 KW (telegraph) at 24 Mc., or 10 KW 100% modulated 2-18 Mc., 7½ KW at 22 Mc. and 6 KW at 24 Mc. These rugged transmitters are worth investigating for your future. Write for full descriptions and specifications.



Center cubical of GATES HF-10 Transmitter illustrates husky tank circuit design for high efficiency coverage over entire frequency range.

GATES

GATES RADIO COMPANY • QUINCY, ILLINOIS, U.S.A.

manufacturing engineers

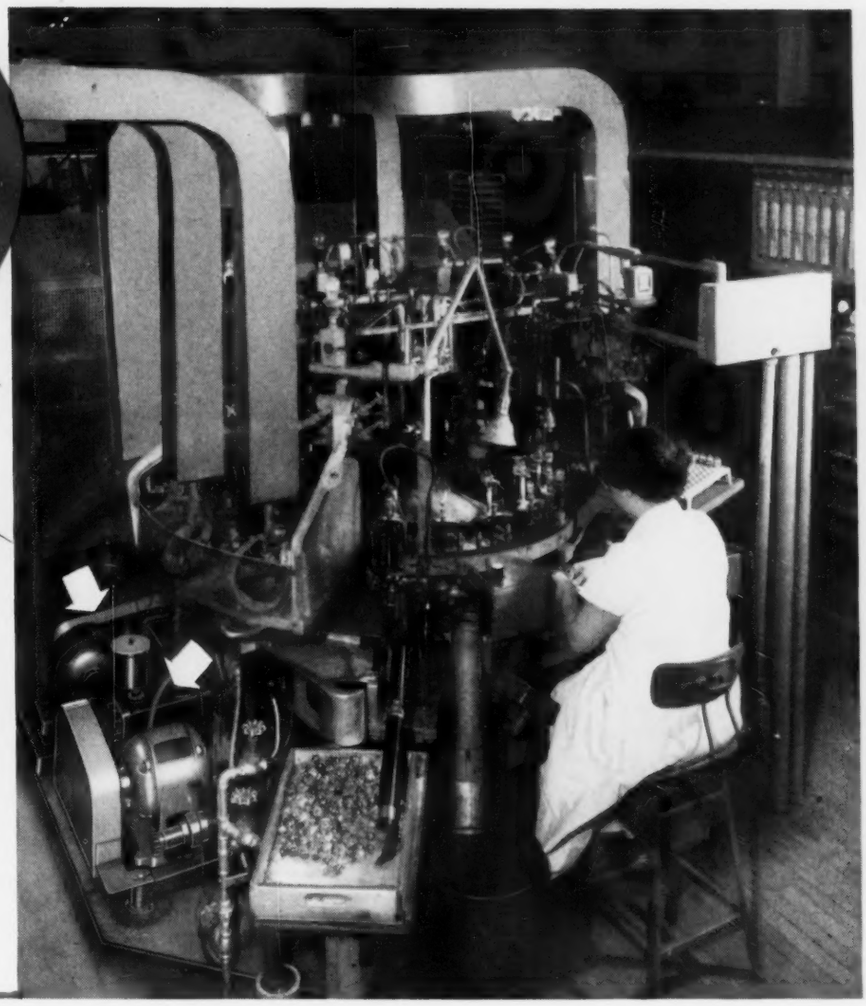
2700 Polk Avenue, Houston, Texas • Warner Building, Washington, D. C. • International Division, 13 E. 40th St., New York City

Canadian Marconi Company, Montreal, Quebec

Western Electric helps ring the bell

with

KINNEY
HIGH VACUUM
PUMPS



Electronic tubes for rural telephone circuits make two trips around this rotary sealing machine before they take the big trip to the country. First, the tubes receive their glass envelopes, after which they are evacuated and sealed under ultra-high vacuum . . . created by Kinney Vacuum Pumps.

To insure proper operation and long tube life, every trace of oxygen must be exhausted from the tubes before sealing. Kinney Vacuum Pumps are used in this and thousands of other automatic exhaust machines throughout the world. They combine these all-important features: fast recovery speed, low ultimate pressures, and complete dependability.

There's a Kinney Pump for every vacuum requirement — whether you're working to 1 mm. Hg., ten microns, or a tenth of a micron — from the new giant 1600 cu. ft. per min. model to the midget Model CVM 3153 with a free air displacement of only 2 cu. ft. per min.

Send coupon today for complete details. KINNEY MANUFACTURING CO., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Houston, New Orleans, Los Angeles, San Francisco, Seattle.

FOREIGN REPRESENTATIVES: Gen'l Engineering Co., Ltd., Radcliffe, Lancs., England • Horrocks, Roxburgh Pty., Ltd., Melbourne, C.I. Australia • W. S. Thomas & Taylor Pty., Ltd., Johannesburg, South Africa • Novelectric, Ltd., Zurich, Switzerland • C.I.R.E. Piazza Cavour 25, Rome, Italy.

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VACUUM PUMPS

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Please send new Bulletin V-51B. Our vacuum problem involves:

- ☐ Vacuum exhausting
- ☐ Vacuum distillation
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- ☐ Vacuum metallurgy
- ☐ Vacuum coating
- ☐ Vacuum research

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Company .....
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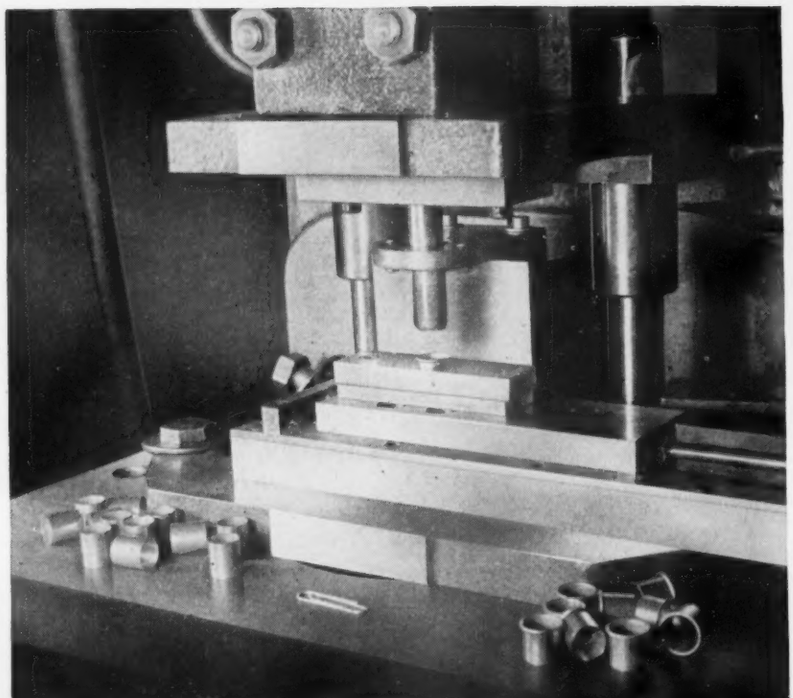
City ..... State .....



Rolled and Bent Tubular Parts

—A Superior Specialty

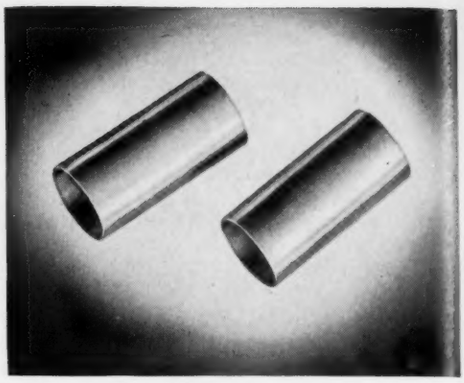
Men, experience, and machines-that-do-everything-but-talk, are generally the answer to a problem of obtaining parts of complex shape and precise dimension.

Here at Superior, customers for parts of this kind get a particularly good answer. We have the experienced men with a solid background of tubular parts production who are willing and able to take the time and care required for top-quality products. And we have the machines.

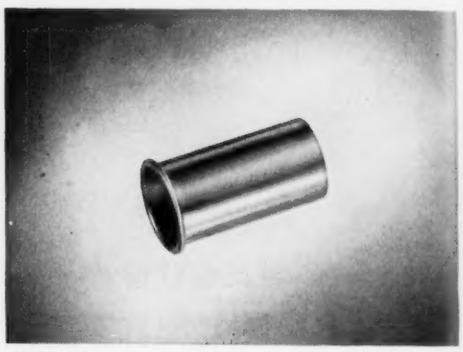
The delivery end of one of them is shown above. The part coming out came into our plant as a 2" tube, went through several redraw and annealing operations, was finally cut to exact length, tumbled to remove cutting burrs, then rolled by a controlled process to the precise dimensions established by customer specifications.

There's nothing spectacular in the story . . . it's just the outline of one of the many jobs that we know how to do well. Behind the story, however, is a thought for you.

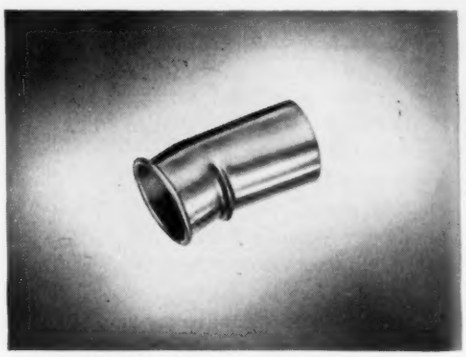
Our production story is backed by our ability, facility and desire to help you. If you are an experimenter in electronics or a manufacturer of electronic equipment and you need a tubular part to do a tough job well, better check with us. We'll be glad to assist with research, development, and design aid toward the solution of your problems. Tell us about them by writing Superior Tube Company, 2508 Germantown Ave., Norristown, Pennsylvania.



Cutting and Tumbling. Cutting machines and jigs of many types and sizes are combined with extensive tumbling equipment to permit fast, accurate production of quantities of parts at Superior.



Fabrication. Parts can be readily rolled at either or both ends, flared, flanged, expanded, or beaded (embossed) as required. The anode above is one of many such parts we produce at high speed and low cost.



The Finished Part. Final stage in the fabrication of the part, shown above at three stages of production, is a bend nicely controlled for both precise angle and freedom from other, unwanted distortion.

This Belongs in Your Reference File

. . . Send for It Today.

NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve—from the refining of the base metal; includes the action of the small percentage impurities upon the vapor pressure and sublimation rate of the nickel base. Future trends of cathode materials are also evaluated.

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All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) Up to 1⅜" O.D.

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VOLUME PRODUCTION *in a hurry!*

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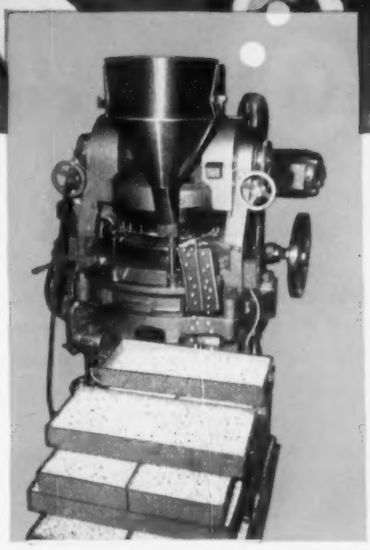
Custom Made Technical Ceramics of this type to meet almost any quantity and delivery requirements.

If you need ceramics similar to these, and you need them *in large quantities,* we have the capacity. This rotary press is capable of producing 1,800,000 units a day and we have 4 large tunnel kilns to insure adequate firing capacity.

For VOLUME PRODUCTION . . . SEE US!



A battery of these rotary presses is ready to serve you. For large volume requirements—a third of a million or over—this is the most economical method of manufacture in the industry.

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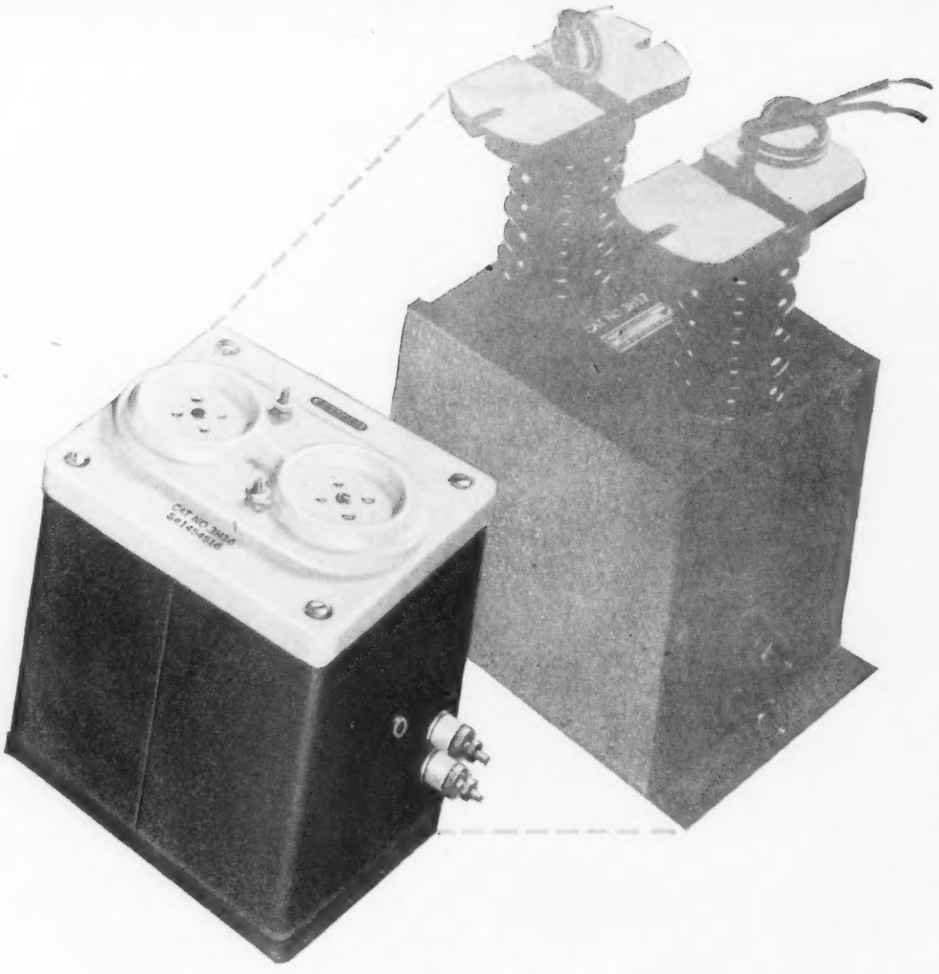

Making little ones out of big ones . . .

Many a design problem has been simplified by the Westinghouse ability to reduce transformer size and weight.

Here, for example, is a case where a transformer was required to work in a voltage-doubler circuit at 18,000 volts. The old model created a space problem.

First step in redesigning, Westinghouse engineers applied a smaller, lighter Hipersil® Core. That, plus improved insulation, made it possible to reduce coil size and spacing. Then a wet-process porcelain cap, with integral tube sockets, eliminated the need for stand-off insulators. The net result was an over-all reduction of 30% in both size and weight of the completed power unit . . . with a great big bonus: The saving to the equipment assembler in installation costs alone made the new design highly profitable, because it was no longer necessary to wire tube sockets.

Savings like this are available to you, too. If size, weight, performance, or quantity production have any bearing on your transformer problem, call your Westinghouse representative, or write Westinghouse Electric Corporation, Specialty Transformer Department, Sharon, Pennsylvania. J-70610

YOU CAN BE SURE... IF IT'S
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TRANSFORMERS

Television's Finest

PORTABLE CAMERA MOUNT

for Complete Mobility

HOUSTON-FEARLESS ALL-METAL TRIPOD

Combines extreme ruggedness, adaptability, rigidity, ease of operation and portability not found in any other tripod. For studio or field use. Levels automatically. Tubular steel legs are easily adjusted for height—lock positively to prevent slipping. Folds compactly. Two sizes: ¾ and full length.

HOUSTON-FEARLESS FRICTION HEAD

Provides smooth, easy panning and tilting of TV cameras. Pans 360° on ball bearings. Tilts 45° up or down with camera counterbalanced at all times. Variable drag and brake are provided on both pan and tilt. Adjustable handle. Fits Houston-Fearless and other standard tripods, pedestals, dollies and cranes.

HOUSTON-FEARLESS TRIPOD DOLLY

Gives convenient mobility to tripod-mounted television cameras. In the studio, it offers a rapid means of moving camera. Wheels swivel for maneuverability or can be locked parallel for straight line tracking. In field, provides easy means for positioning camera. Strong, lightweight tubular steel. Folds compactly.

Write for information on specially-built equipment for your specific needs.

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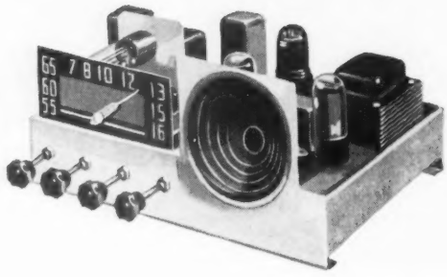
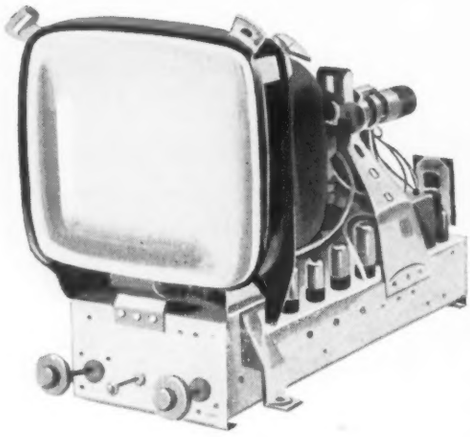
FOR RADIO



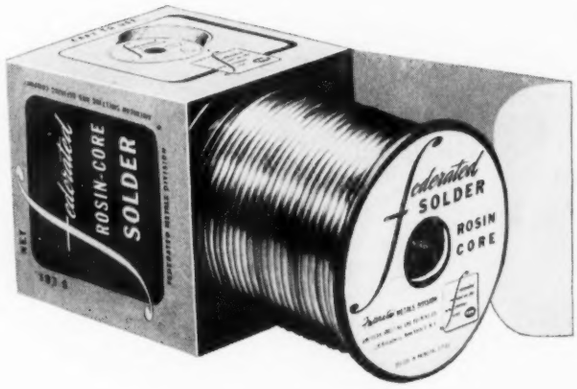
AND

TV



SOLDERING THAT LASTS...

USE...



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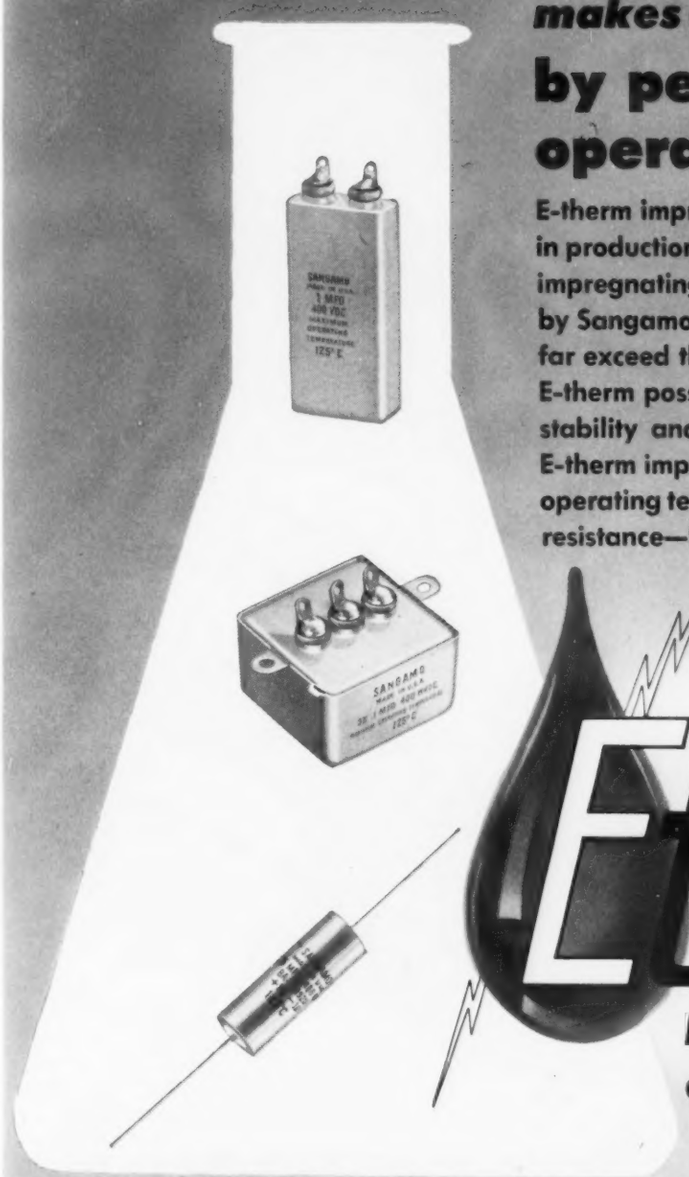

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Let's Get Action on TRANS-ATLANTIC TV!

To the President,

The White House, Washington, D. C.

Dear Mr. President:

Right now, TV networks link practically every TV station in the United States. And this month, Canadian and Mexican transmitters are to be added to the American continental system.

Next step in TV networking obviously must be to Europe and South America.

Many methods for trans-ocean TV have been proposed and discussed:

1. Airplane-relay between a dozen or more express planes continuously flying a regular route across the ocean.
2. "Stratovision-relay" between "stationed" planes flying in circles over a series of flat-top carriers suitably spaced at ocean intervals.
3. A microwave and VHF relay chain up the Labrador coast, across Greenland and Iceland to the British Isles.
4. A submarine cable using new coaxial techniques and employing transistors to reduce current drain of the many repeaters required.
5. Long-distance "scatter" transmission, offering possibilities with increase of transmitter power.
6. Miscellaneous marginal proposals, including moon reflections during limited (5-hour) periods at varying times.

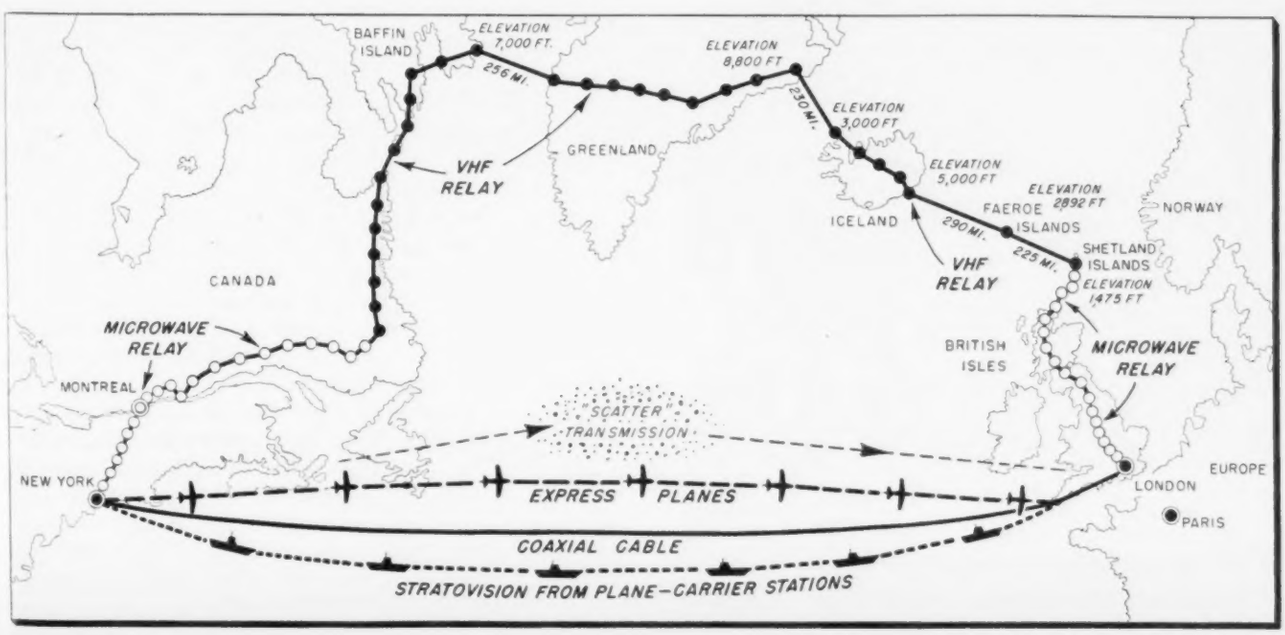
But even with a standard US TV signal delivered across the Atlantic at adequate level, another set of difficulties arises from the differences in video specifications "over there." Our 525-line picture would have to be converted—for England, 405 lines; Holland, Denmark and Germany, 625 lines; Belgium, 819 lines; and France, 441 and 819 lines.

Yet all these baffling difficulties undoubtedly will be overcome, when the tremendous significance of trans-Atlantic TV is fully appreciated. Not only will the great news events of Europe be brought "live" into 20 million American homes, but the underprivileged of Europe can be shown the wonderful richness of life in America, our great cities, our comfortable modern homes and farms, our bulging food stores, our labor-saving devices, our modern factories with ideal working conditions, our freedoms for all individuals.

Surely trans-Atlantic TV will work new miracles of world understanding and better appreciation of American ideals. In addition to the "Voice of America," we shall be able to give them "The View of America."

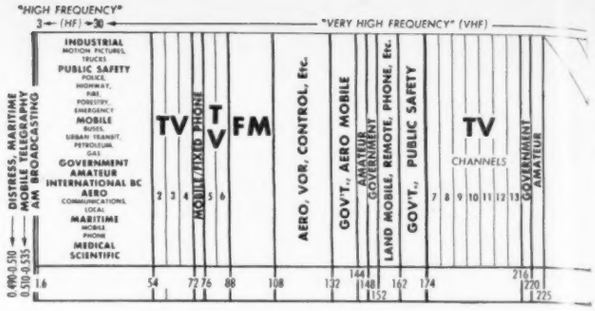
To speed up this interchange of television programs across the Atlantic, we urge that you, your Secretary of State, or your White House Telecommunications Adviser, the eminently qualified Haraden Pratt, immediately appoint a technical committee to investigate the feasibility and cost of such a TV over-ocean link, and report to the President and Congress the funds and methods needed to get fast action on Trans-Atlantic TV.

Publishers, TELE-TECH



RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications

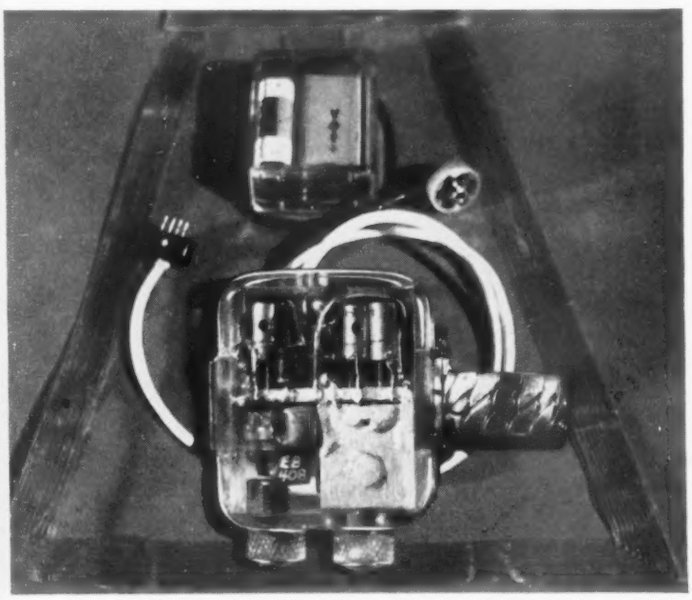


REARMAMENT

EXCEEDS WORLD II PEAK—Electronic-radio-radar production is now up to a total of $4 billion, exceeding peak output of the industry during World War II. With the production of equipment and components at $2.5 billion on an annual basis for the armed services, it is anticipated that electronic military production will be increased by more than 50% before the end of this year, after which it will level off. Production of civilian television and radio equipment and replacement parts and components now totals approximately $1.5 billion a year, which combined with the military output totals $4 billion. Manufacturing of electronic and radio components is eight times what it was in the three months following the Korean war's outbreak, and more than three times what it was a year ago.

MOBILE COMMUNICATIONS

TWO-WAY TRANSCEIVER manufacturers are aiming at increasing the "average man" market in UHF and VHF marine and vehicular equipment. In order to keep equipment cost commensurate with the amount paid for the vessel or vehicle itself, this market's prime requisite is low selling price. Extreme congestion in the 2 MC band is the natural outgrowth of the operation of 28 000 small craft equipped with radio communications systems, many of whom are unaware of the need for efficient message handling. As more low-cost transmitters and receivers become available for the VHF frequencies recently provided by the FCC for marine use, small boat operators will climb into the new bands to escape the crowding at 2 MC. Similarly, in land mobile applications at 450-460 MC, and particularly in the 460-470 MC Citizen's Band, satisfactory radio systems within the scope of our "average man" will find an increasingly receptive market among construction companies, newspapers, taxicabs, civic services, repair and delivery businesses, and professional people who desire direct contact to a home office.



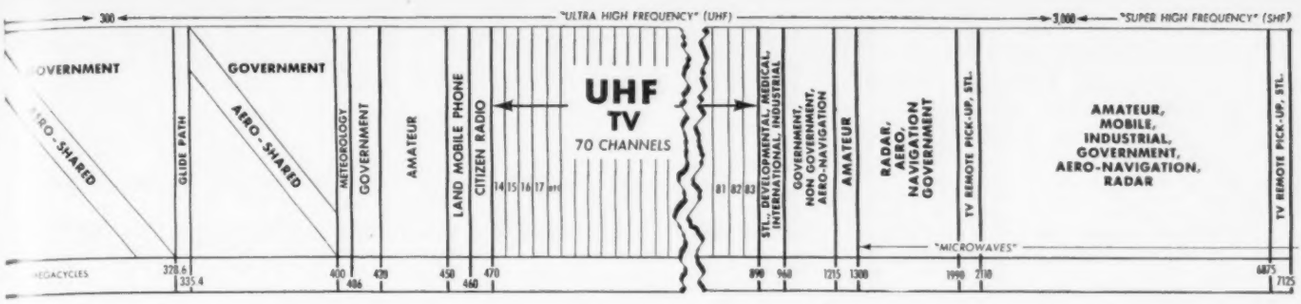
First wristwatch radio made by Western Electric engineers as an "after-hour" stunt is 1.5 x 2 x 0.75 in. Unit uses one transistor in r-f stage, one in detector and two in audio. Battery supply (top) and tuner-amplifier are surrounded by antenna worn in user's jacket

ALLOCATIONS

TWO YEARS EXPERIENCE with the Copenhagen Plan for radio in Europe shows that it is working better, but not by any means as efficiently as its signatories intended. Of the 675 medium and low frequency stations in operation in the European area, about 150 have been added in the past two years. At the end of this two-year period there were 350 utilizations of various frequencies. This seems to indicate that congestion has reached such a state in Europe that very few channels now remain free of interference. About 40% of the frequency utilizations are contrary to the Copenhagen Plan. Frequency tolerances of ±10 CPS seem to be taken rather lightly, since only 55% of the stations using authorized frequencies are maintaining their tolerance. Some of the unauthorized stations operate on frequencies more or less midway between the nominal channel frequencies. It is interesting to note that the 350 stations operating aggregate approximately 18 megawatts of power, and also that networking in Europe is reaching considerable proportions.

SPACE RADIO

DOPPLER SHIFT—The moon-reflected messages being transmitted on 418 MC from Collins Radio, Cedar Rapids, Iowa, to Washington, D. C., start out at a low angle of 7 deg. above the horizontal, directed at the rising moon. An incidental result is that the earth's rotation is then bringing the transmitter closer to the moon-reflector at a speed of nearly 1000 m.p.h. Also the receiver is approaching the moon but at a slightly lesser speed because of the higher moon angle at the receiving point. These two speeds should produce a Doppler frequency-shift of 1000 CPS—about the band-width of the receiver. But tests so far have been too rough to measure this increase in frequency between the 20-KW transmitted wave, and the faint receiver signal (with a power of only 7.25 times 10-to-the-minus-seventeenth-power watts, or an attentuation of 250 billion billions during its half-a-million-mile journey!)



COMPONENTS

EARLIER TREND towards permanent-magnet loudspeakers and separate filter chokes for the B+ supply in television receivers, may well be reversed due to the shortage of permanent magnet material, and the comparatively low cost of loudspeakers with energized field windings. Today a manufacturer who pays 80 cents for a permanent magnet loudspeaker and 55 cents for a filter choke, totaling $1.35, can save 18 cents by using a loudspeaker with an energized field winding at a cost of $1.17. This reversed trend in components may well spread to other sections of television and radio receivers, and some of the very early component combination units may be revised and cheapened in the light of present day know-how.

QUALITY CONTROL

WOMEN TESTERS—Some of the larger equipment manufacturers are turning to the idea of using only women testers on their assembly lines. The thinking here is that men testers, because of limited subject knowledge or experience, are more likely to interpret wrongly or to read things into meter indications and these may not always be correct. With women testers, on the other hand, meter readings are likely to be on a true "go or no-go" basis. The end result is reported to be better quality in the manufactured product.

PROPAGATION

TV SOUND LAG—Only the TV pictures go by way of microwave relay or coaxial cable, at speeds averaging 160,000 miles per second (approaching the velocity of light. The circuits carrying the sound accompanying television channels, on the other hand, are usually composed partially of loaded cable facilities which transmit at much lower speeds, in some cases as low as 20,000 miles per second. Also these sound circuits often follow different routes than the video circuits, as they are sometimes used by the broadcasters for other purposes. As a result there may be many more sets of terminal equipment in the circuits than would be required simply to reach the television stations along the route. The net result of these differences is that the time required for transmission of the sound to distant points may be enough longer than that required for the video, so that a lag in the sound might be noted under certain conditions,—for example, in watching the lip motions of a speaker close to the camera. In other types of action delay may be relatively unnoticeable.

To avoid objectionable delay effects it is necessary to design sound circuits for television so that the delay of the sound (compared to the video) between program sources and distant areas under any conditions, will not exceed a certain limit. As is the general case in designing communication channels, meeting closer limits involves added cost. No permanent limit has been established yet for audio delay but experience so far indicates that something less than a tenth of a second will probably prove optimum, all factors considered, including cost.

INTERNATIONAL

HIGH-DEFINITION TV link from Lille to Paris, France, is now in operation. Operating over about 130 miles, a three-step microwave relay is now working on a frequency of approximately 900 megacycles. Used for high definition television the band width is 15 megacycles. Single, upper side-band transmission is used over the link, which also carries the frequency modulated audio component of the program. An over-all signal-to-noise ratio figure of 35 db has been obtained.

TV programs from Paris were relayed to London during July. Two broadcast transmitters covered the Paris area, one using 819-line scanning, the other the old 441-lines. The 130 miles to Lille were spanned by three 900-MC links; thence over 180 MC to Cassel, where 819 lines were changed to British 405-lines. Signals were relayed to Alembon at 7000 MC. Remaining 122 miles to London were covered by three 4500-MC links.

Magnetic Powder Cores for Military

Extreme variations in volume resistivity, permeability materials made by different manufacturers point to

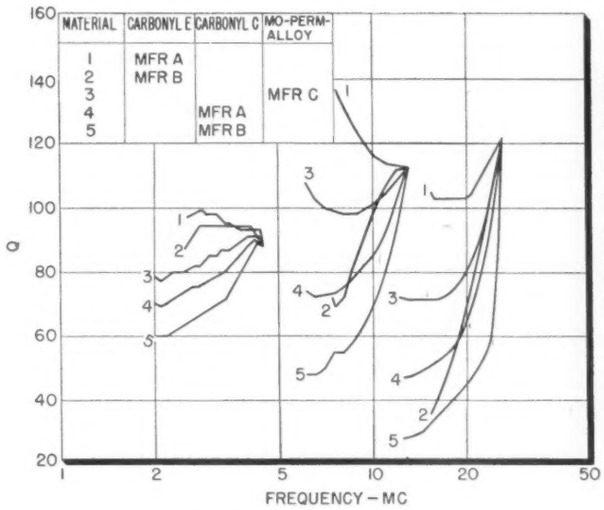


Fig. 1: Q vs. frequency for various grades of powder cores

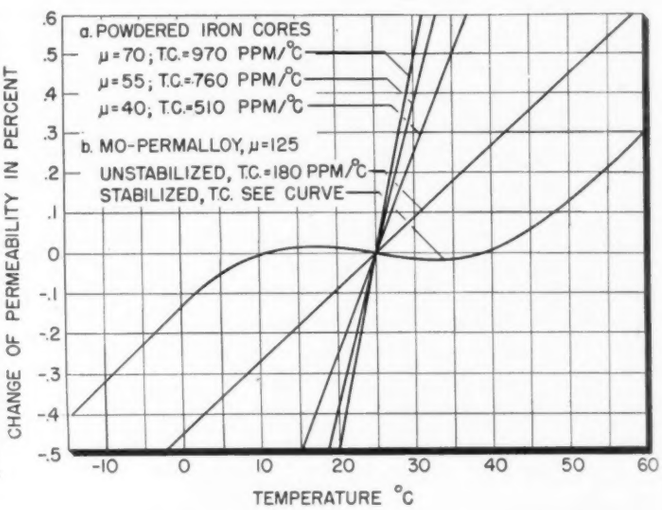


Fig. 2: Effect of temperature on permeability of different cores

By Dr. EBERHARD BOTH
Squier Signal Lab., SCEL, Ft. Monmouth, N. J.

IRON powder cores are not as simple structures as their outward appearance might imply. The very powder of which they consist comes in more than 20 grades all more or less different from each other with regard to purity, particle size and shape, hardness, density, and intrinsic magnetic properties such as permeability and losses. In a finished core, these characteristics will be varied still further by manufacturing parameters such as the packing fraction of the powder, interparticle insulation, nature and amount of binder, molding and curing technique, and unless the cores are magnetically closed structures like toroids, their two most important characteristics, i.e., their permeability and Q values, will even depend upon the core dimensions.

It is therefore not surprising that, when the 25 different powder grades listed in the MPA chart are compounded into cores by more than a dozen manufacturers, the result is not 25 grades of powder core materials but probably closer to 200. The great variety of materials available is not necessarily a cause for alarm by itself, although probably both the core manufacturers and the core users would benefit, if the number would be reduced to the minimum required for the adequate coverage of the frequency range from 10 KC to 100 MC, which in all probability could be done with a well chosen series consisting of about twenty materials. What is disturbing, however, is the fact that these materials, when used in military equipment under conditions for which they were never intended, will be susceptible to a variety of temporary or permanent changes which may seriously impair the function, or even cause the breakdown of the equipment.

This article will describe the present and anticipated military requirements for cores, present performance characteristics, illustrate the reality of the shortcomings of present materials for such use, and suggest such action as is deemed necessary.

Iron powder cores have been used in Signal Corps equipment since the days of World War II. They are particularly suitable for tuning applications, where the ganged capacitors of resonant LC circuits are replaced by variable inductances. This results in considerable savings in weight and space, and in higher electrical and mechanical stability. Permeability tuning is therefore used exclusively in all newly developed broadband receivers, with the result that some sets contain as many as 50 powdered iron cores in r-f and i-f transformers, oscillators, and other fixed and variable inductances.

High Performance Standards

These sets must maintain high standards of performance under the most trying conditions of modern warfare. They must, within very narrow limits, maintain their calibration and sensitivity in spite of rough handling, long storage, temperature extremes, fungus and dampness.

It seems that iron powder cores have somehow escaped complete individual scrutiny heretofore, because the burden of selecting the proper material was placed on the contractor who was only held to the performance specifications of the finished set. Under this practice, the manufacturer had to find out the hard way which materials would cause trouble. The danger of this procedure is that short time tests

Communication Equipment

temperature coefficient and Q for similar core need for further study and standardization

can never give any assurance about stability over extended periods of time, so that unsatisfactory materials may slip through unnoticed.

In order to get some idea whether there is cause for being alarmed over the susceptibility of powder core materials to stressed environmental conditions, a series of tests was performed at the Signal Corps Engineering Lab., Ft. Monmouth, N. J. Unfortunately, only about 200 different materials made by three manufacturers could be included in this series, but it is hoped to resume this work on a broader basis in the near future. In spite of their preliminary nature the results are being reported here in order to show that the shortcomings of present materials are real and can be detected by relatively simple and dependable test procedures.

One of the prominent uses of powder cores in Signal Corps equipment is in permeability tuning. The performance of the material for this particular application is judged by the tuning range which a slug of a given size will afford and by the amount of losses which it will introduce into the resonant circuit. Typical performance curves for five different materials over three frequency bands are shown in Fig. 1. These data were taken by R. Miedke of Collins Radio. The tuning slugs used were 1.5 in. long and 0.25 in. diameter.

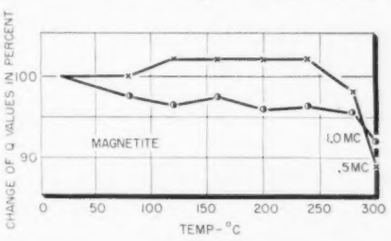


Fig. 3: Permanent change of Q caused by holding magnetite at elevated temperature

The three common end points of the curves show the resonant frequencies and Q values of the coils with the cores removed, while the curves extending to the left from these points represent the Q values at decreasing resonant frequencies corresponding to various degrees of insertion of the core into the coil. The length of each curve is then a direct measure of the tuning range, and the most desirable material is that which combines the greatest tuning range with the smallest change in Q.

Materials numbered 1 and 2, made from Carbonyl E powder by two different manufacturers show a rather short tuning range for all three frequency bands. It should be noted that, while their curves for the lowest frequency band are very much alike, their behavior becomes altogether different at the higher frequencies. Materials 4 and 5 are made from Carbonyl C powder by the same two manufacturers. While their tuning range is substantially greater than that of materials 1 and 2, the Q values are lowered to an intolerable degree by the insertion of the cores. Definitely superior, however, is material 3 which gives the same or better tuning range as compared to the other materials at a much smaller sacrifice in Q. Material 3 is a Molybdenum-Permalloy powder core and its performance has not yet been equalled by any core made from powdered iron.

Permeability Temperature Coefficient

Another important feature of powder core materials used in tuning applications is the temperature coefficient of permeability. This is particularly true in cases where toroids

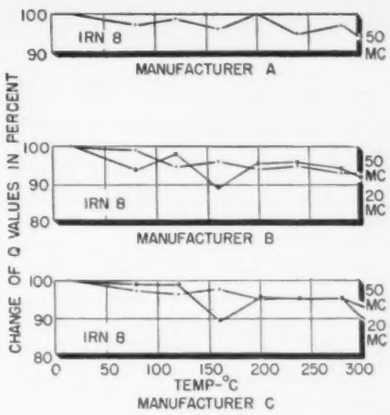


Fig. 4: Permanent change of Q caused by holding IRN 8 at an elevated temperature

are used for fixed turning, a practice which is becoming more and more common with the progress of miniaturization. Very little is known about the temperature coefficients of permeability of the various grades of powder cores. In a general way, it can be said that the temperature coefficient is roughly proportional to the permeability of the material. Fig. 2 compares three powdered iron materials[1] with two Molybdenum Permalloy powder materials.[2] The permeabilities of the powdered iron are 70, 55 and 40, and the respective temperature coefficients are 970, 760, and 510 PPM/°C. The permeability of the Molybdenum-Permalloy is 125 and the temperature coefficient of the unstabilized material is 180 PPM/°C, while the stabilized version of this material shows a minimum permeability change above and below room temperature and averages about 50 PPM/°C over the temperature range from 0°C to 50°C. The peculiar behavior of the stabilized material is produced by using a blend of powders of varying composition, the major constituent being the normal Mo-Permalloy to which a small amount of an alloy with a

TABLE I

VOLUME RESISTANCE BEFORE AND AFTER HEAT TREATMENT

POWDER GRADE	MANUFACTURER A	MANUFACTURER B	MANUFACTURER C
	Volume resistance in megohm—cm		
	As Received		
Carbonyl C	2,870.0	0.000,516	
Carbonyl E	50,000.0	0.17	36.0
Carbonyl SF	50,000.0	2,455.0	
Carbonyl TH	50,000.0	39.9	8,980.0
IRN 8	0.097	3,710.0	122.0
	After Aging At 300°C		
Carbonyl C	0.000,433	0.000,001,76	
Carbonyl E	0.012,9	0.000,035	0.001,085
Carbonyl SF	0.008,76	0.000,338	
Carbonyl TH	0.018,980	0.000,882	0.001,910
IRN 8	0.057	12.95	1.938

strongly negative temperature coefficient is added. Similar practices may well become necessary for iron powder cores. It is true that the temperature coefficient of a slug is substantially reduced along with its effective permeability but the *Antara Catalog*[3] lists values from about 15 to 170 PPM/°C for standard cores, depending on the material. Temperature coefficients of this magnitude are apt to cause trouble in circuits where high thermal stability is required, particularly if the values vary from batch to batch due to inadequate production control.

Effects of Aging

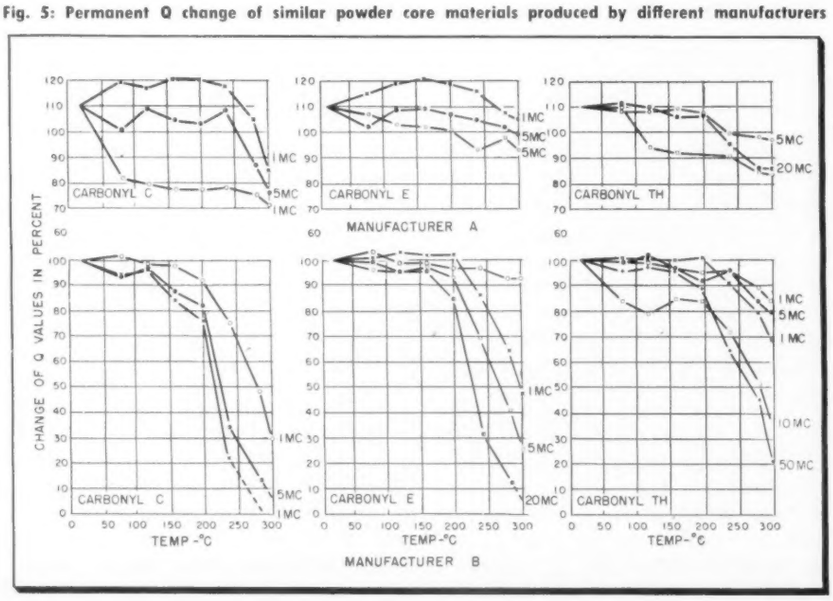
In view of the clear trend towards higher operating temperatures in miniaturized communication equipment it seemed interesting to check how stable present commercial powder cores are, when subjected to aging far above room temperature. A series of plain slugs 0.500 in. long and 0.370 in. in diameter were held for one hour at temperatures of 80, 120, 160, 200, 240, 280, and 300°C, with intermediate cooling to room temperature for testing the Q values. One of the same core was used for all temperatures, so that at the end of the test series it had undergone seven heating and cooling cycles with increasing peak temperatures.

The Q readings were taken in a series of coils designed according to an article published in the Jan. 1946 issue of *Electronic Industries*. The slugs were tested at the frequencies for which the materials are recommended by their manufacturers. In order to compare the results of these tests, the Q reading in the "as received" condition was taken as the 100% reference point and the percentage of Q as retained after each heat treatment was plotted versus the applied peak temperature.

TABLE II
VOLUME RESISTANCE BEFORE AND AFTER MOISTURE TEST

POWDER GRADE	MANUFACTURER A	MANUFACTURER B	MANUFACTURER C
	Volume resistance in megohm—cm		
	As Received		
Carbonyl C	2,870.0	0.000,516	
Carbonyl E	50,000.0	0.170	36.0
Carbonyl SF	50,000.0	2,455.0	
Carbonyl TH	50,000.0	39.9	8,980.0
IRN 8	0.097	3,710.0	122.0
	After Moisture Resistance Test		
Carbonyl C	13.75	0.105	
Carbonyl E	50,000.0	54.5	50,000.0
Carbonyl SF	1,615.0	50,000.0	
Carbonyl TH	50,000.0	50,000.0	37,300.0
IRN 8	2.0	0.571	50,000.0

Fig. 5: Permanent Q change of similar powder core materials produced by different manufacturers



A few representative results are given in the following illustrations. A low permeability material, compounded from magnetite powder and tested at 0.5 and 1.0 MC is shown in Fig. 3. It has a very satisfactory stability up to 240°C, and even after holding at 300°C it retains about 90% of the original Q.

Fig. 4 contains data on three materials, all compounded from IRN 8 powder but produced by three different manufacturers. These materials are also of the low permeability variety and their stability is satisfactory up to the highest temperature.

Fig. 5, however, tells a different story. It gives the results of six materials made by two manufacturers from the three carbonyl iron powder grades C, E, and TH. It is clearly evident that the retained Q values are not so much determined by the raw materials used but by the different production methods of the two manufacturers. In the materials made by manufacturer A (top row), the Q begins to change after the first aging treatment at 80°C, but remains fairly constant during the subsequent treatments up to 300°C, with final Q values of 60% or better of the as received value. The same raw materials as processed by manufacturer B (bottom row) show only slight effects of the heat treatments up to 120, 160, and 200°C for the C, E, and TH powder respectively, but their Q values break down abruptly above these limits.

Values Summarized

Fig. 6 summarizes the Q values obtained after the final 300°C treatment, but plotted here versus frequency. The three IRN 8 materials represented by the dash-dotted lines between 2 and 5 MC *show the best* stability. The Carbonyl C grades marked by the dotted lines show the greatest spread, with one staying above 60%, retaining Q up to at least 1 MC, while the other one drops to zero at 0.5 MC. Two groups are also observed in the Carbonyl E grades represented by the dashed lines, with one pair of curves dropping to zero at 10 MC, while another pair remains above 80% at that frequency. The Carbonyl TH grades shown by the solid lines split also into two groups, however the difference is not as spectacular as with the other materials.

The effective permeability of the slugs proved to be much more stable than the Q values, with maximum changes observed in the order of 10%.

Spectacular changes occurred,

(*Continued on page* 100)

Uninterrupted Power for Microwaves

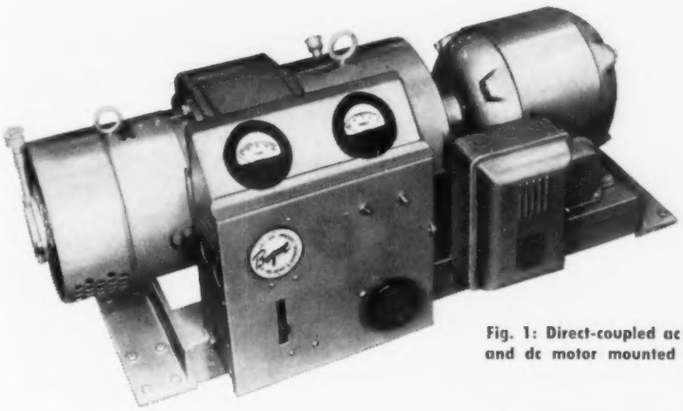


Fig. 1: Direct-coupled ac motor, alternator and dc motor mounted on common base

Supply arrangement for relay systems uses ac motor, alternator and dc motor in tandem. Batteries employed as standby source in case of power failure

By LEO G. SANDS,
President
Bogue Railway Equipment Div.
Bogue Electric Manufacturing Co.
52 Iowa Ave., Paterson 3, N. J.

COMMUNICATIONS systems are subject to interruption from a number of causes such as tube and component failure, equipment, instability, tropospheric disturbances and failure of the electronic power source. This article will discuss ways and means of providing continuous electrical power for the operation of communications equipment.

Power failures seldom occur in metropolitan areas, and therefore a stand-by power source is not as important a consideration as it is in sparsely settled regions. Continuous availability of electrical power is of prime importance in microwave relay systems because every repeater station is a vital link. Most microwave repeater stations are provided with some sort of stand-by power equipment to insure operation with minimum outage time. Telephone and telegraph carrier repeaters and teleprinter circuits depend on continuous power availability for uninterrupted operation.

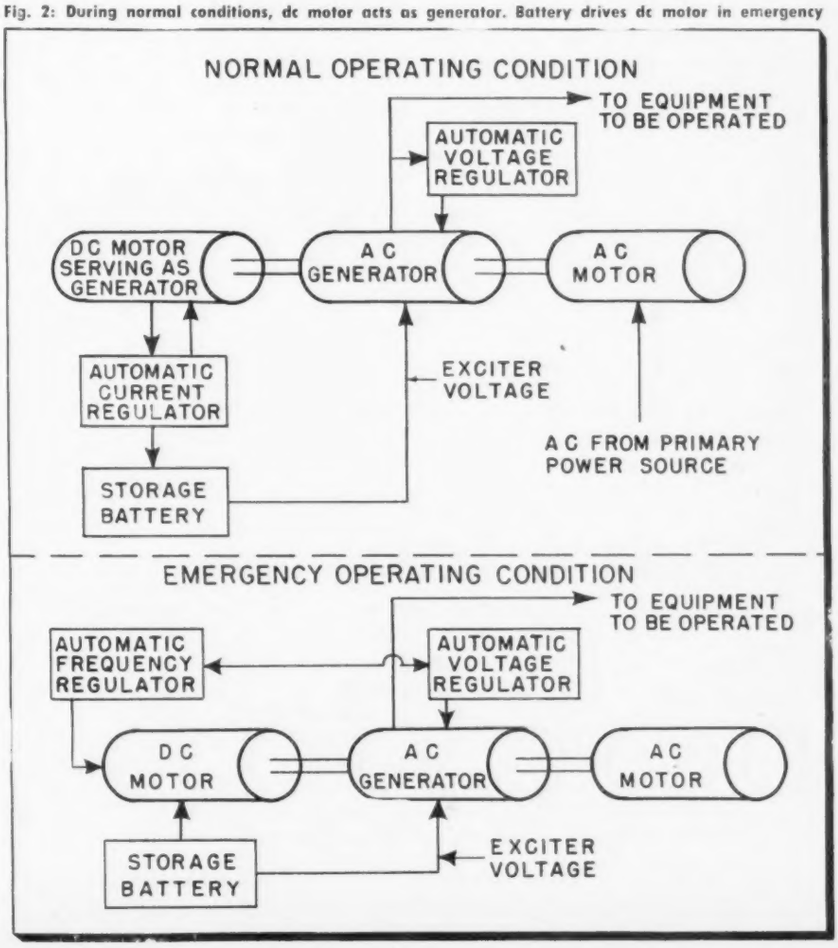
The most common source of stand-by power is the combustion engine driven alternator which starts automatically when primary power fails, and shuts off when regular power service is restored. The flow of power is interrupted during the period of time required for the engine to start and for the power to become constant in frequency and voltage.

Where this interruption of power is of great import, stand-by batteries are sometimes employed. If the communications equipment requires ac, a vibrator or rotary type converter is operated from the dc source. Failure of primary power causes the stand-by battery and converter system to start furnishing power. To avoid even this fragment of time required for the conversion equipment to start functioning, communications equipment has been designed using large filter capacitors to sustain plate voltages at a suitable level for a fraction of a second.

To provide uninterrupted power, some communications equipments are powered at all times from batteries which are floated across a battery charging generator or rectifier. Failure of primary power source normally used for battery charging causes a stand-by engine generator to take over the job of replenishing the energy in the batteries. Some marine radio systems utilize motor generator sets to con-

(*Continued on page* 106)

Fig. 2: During normal conditions, dc motor acts as generator. Battery drives dc motor in emergency



Fuse Protection for

Overload and frequency characteristics of fast, medium
Categories employed in military gear indicated. Fuse

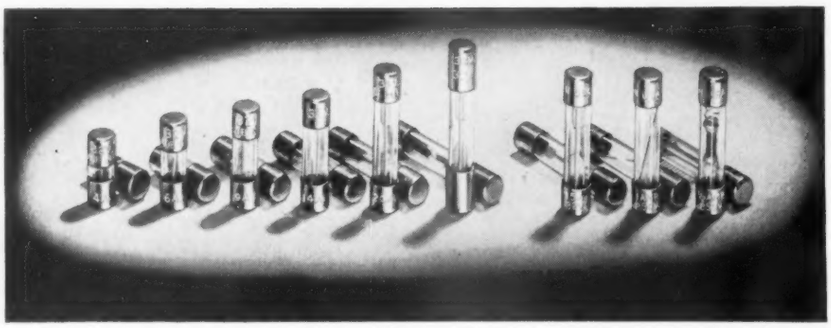


Fig. 1: Most popular fuses for electronic applications (r) and auto radio current-length types (1)

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FORTUNATELY for the fuse manufacturers, the number and types of fuses and fuse mountings required by the electronic industry has developed over the past 25 years in about the same proportion as that of resistors and capacitors. In the same way, too, the pressure from engineers has been to make fuses smaller and better. The purpose of this paper is to sketch in outline: (a) standard fuse types, (b) the reason for such types, and (c) where they are used in the electronic industry.

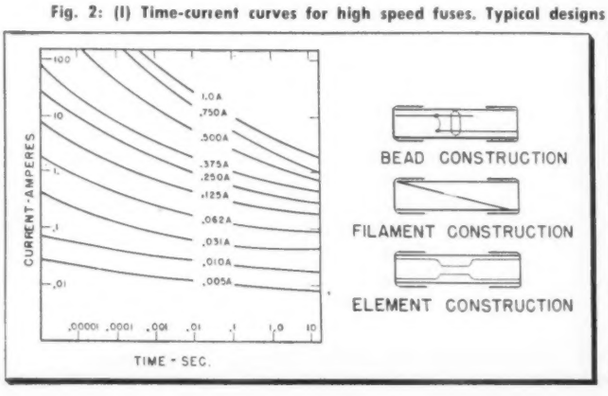
By far, the greater number of fuses used for electronic components protection are glass enclosed, although steatite is used for higher current, 250 v. Underwriters Laboratories approved fuses. The most popular fuses and their sizes and maximum ratings as used by the industry (see Fig. 1) are as follows: 8AG—1 x 1¼ in. diameter, max. 15 amps, 125 v.; 3AG—1¼ x ¼ in. diameter, max. 6 amps, 250 v. and 20 amps, 32 v.; 3AB—1¼ x ¼ in diameter, max 20 amps, 250 v. and 30 amps, 125 v.; 4AG—1¼ x 9/32 in. diameter, max. 40 amps, 32 v.; 5AG—1½ x 13/32 in. diameter, max. 60 amps, 32 v.

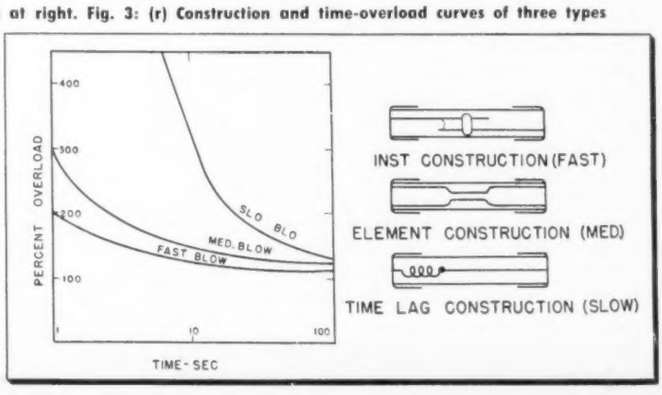
It will be of interest to engineers that there is no logical or rational relationship between the recognized "AG" designation and the physical size of the fuse. It grew over the last 35 years like Topsy, starting with the automotive industry. 1AG was the first "Automotive Glass" fuse; 2AG was next, but is no longer used; 3AG was next, etc. of interest also is the size-rating combination now generally used in the automotive industry and covered by specifications set up by SAE. Their principal use in the electronic industry is for automobile radios.

Fuse Characteristics

Since fuses are the safety valves of electrical circuits, it is important they operate or "blow" before damage occurs in the equipment being protected. On the other hand, they must not blow too easily and cause nuisance outages. In other words, the time current characteristics of the fuse must conform to the "time-damage" characteristic of the equipment. Note Fig. 2. To provide such protection adequately, three general time-current characteristics have evolved in fuses for electronic equipment over the last 15 years. They have been designated as: (a) fast—Hi Speed, (b) medium lag, and (c) time-delayed fuses. The latter are often referred to as Slo-Blo, Fusetron, etc. See Fig. 3. Such terms are not scientifically accurate and it is hoped that more technically accurate terms may be evolved over the next 15 years. Also, the above terms are naturally relative; for instance, the lag that would be considered "delayed" in a ¼ ampere fuse would, at the same degree of overload, be considered fast or medium lag in a 20 ampere rating. By the same token, high current equipment will normally carry overloads longer with safety than will low current equipment.

Fig. 2: (l) Time-current curves for high speed fuses. Typical designs at right. Fig. 3: (r) Construction and time-overload curves of three types





Electronic Equipment

and slow blow types explained. selection for various applications

Before outlining the places various types of fuses are used, it might be well to point out that all fuses used in 115 and 230 v. lighting lines are or should be Underwriters' Laboratories approved. For the most part, these are the 8AG, 3AG and 3AB types. It would be more accurate to say U.L. is concerned with fuse use and performance where a fire or shock hazard exists. Their specifications are contained in their bulletin entitled "Fuse Standards."

In general, U. L. calls for approved fuses of the above types to operate as follows:

Carry 110% of rating.

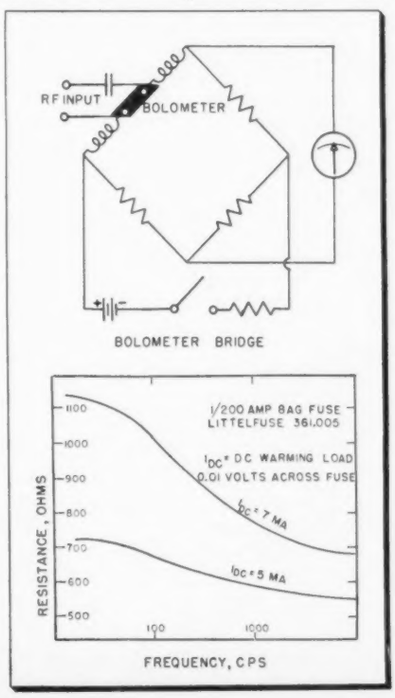
Blow at 135% in one hour.

Blow at 200% in less than 60 seconds.

Carry rated current with less than 70°C temperature rise.

Electronic gear for the military services use the 3AG, 3AB, 4AG, 5AG and 8AG almost exclusively. Specifications for these fuses are adequately covered by the new MIL F-15160-A. This standardization by the services is most commendable. Previously, each service had its own stock numbers and often different drawing and part numbers. Through standardization, some 465 fuse items used by the Services may be reduced to half of that number.

Fig. 4: High speed action of platinum filaments used in low-range instrument fuses illustrated by use as bolometers. Frequency response of 0.000037 in. diameter platinum filament shown



Fuse Selection

We will now classify circuit protection applications under the three general lag characteristics outlined above:

Fast Fuses: Protected by the category of fast fuses are meters of both D'Arsonval and thermocouple types, tube filaments, TV sets and applications where high speed action is essential. The fuse elements used in these fuses (8AG) are chosen to have the lowest possible mass; in the finer ratings platinum is generally used. An interesting application for one of these fuses (such as a 1/100 amp rating) is as a bolometer; that is, it is utilized as a terminal impedance in high frequency circuits.

Fuses as low as 1/500 amp ratings are available from stock. The filament in this fuse is only 0.000020 in. diameter. Such a filament is small enough to follow the heating and cooling cycle of frequencies 2,000 to 3,000 CPS. The "frequency response' of a filament of 0.000037 in. diameter is shown in Fig. 4.

Medium Lag: It is estimated that about 80% of all fuses used by the electronic industry are of the medium lag type. Of these, 75% are used in the 115 v. primaries of power supplies of all types. They are the inexpensive work horses of the fuse industry, selling from 1¢ to 2¢ each, which accounts for their being specified so generally instead of circuit breakers. Some of the most typical applications are shown in Fig. 5. Most manufacturers use zinc wire or strip for the elements of these fuses; usually one-piece simple affairs. Zinc has many good qualities for this purpose, but has a basic weakness in recrystallizing at temperatures about 200°C. An industry-sponsored research project to develop better fuse element materials would do both customers and manufacturers far more good than the constant struggle to make fuses as cheap as possible.

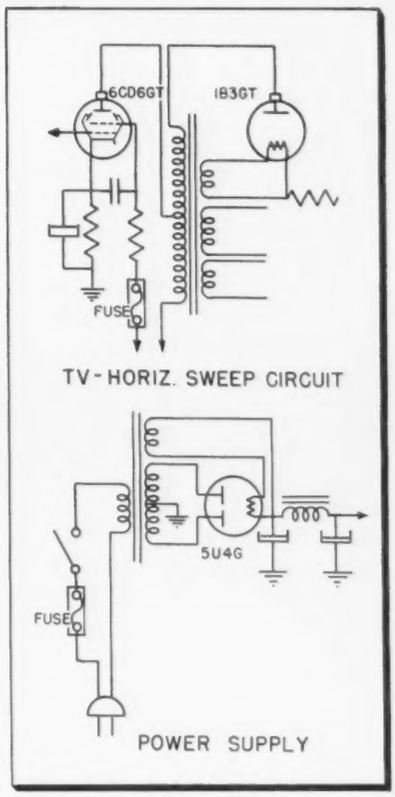


Fig. 5: Typical applications of inexpensive medium lag type in sweep and supply circuits

It is in the field of medium lag fuses that the greatest extension of ampere and voltage ranges (and therefore usefulness) has taken place, over the past 15 years in particular. While all fuse lines have been extended in both current and voltage ratings over this period, the most actively developed has been the 3AG and 2AB lines, the growth of which it will be interesting to outline.

Fuse Development

In 1933 the 3AG fuses were listed and approved by Underwriters' Laboratories up to 3 amps, 250 v. In response to the requirements of the electronic industry, this was increased by gradual steps to 8 amps, 250 v. in 1938. At 8 amps, it became almost impossible to produce glass enclosed fuses that would not shatter under short circuit at the U. L. test at 10,000 amps and 250 v. dc. At that point, bakelite was used (3AB), but later during World War II years through the use of steatite fuse bodies, ratings were extended up to 15 amps. This represents the maximum U. L. will approve due to classification reasons, although we can

(*Continued on page* 96)

Fig. 1: Tuning, power and antenna changeover knobs protude from front of the completed unit

Performance and

Continuous tuning from 470 to 890 MC provided sion line. I-F amplifier with 21 db gain feeds di-

By H. F. RIETH, Chief Engineer
Kingston Products Corp., 1415 N. Webster St., Kokomo, Ind.

Fig. 2: Rear view shows panel board terminals for UHF antenna, VHF antenna and VHF receiver

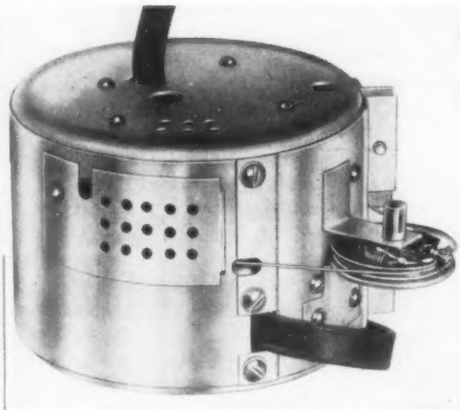
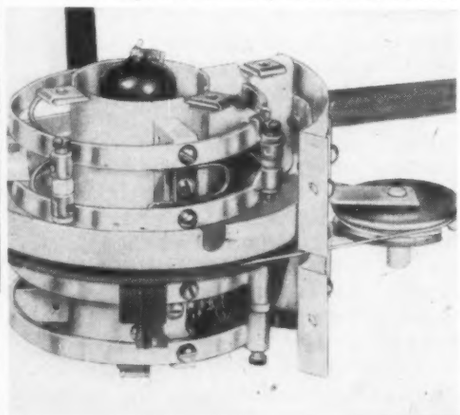


Fig. 3: UHF tuner removed from converter chassis with all covers and shields remaining in place

Fig. 4: Top view shows preselector lines with their respective trimmers, and cascode i-f tube



THE UHF TV tuner described here utilizes tuned line microwave principles. The mechanical design lends itself to a small basic package with simplicity of production and alignment. The tuner diameter is 4 in. and depth is 3 in. It is of the "continuous tuning" type with a dial drive shaft covering the 70 channels from 470 to 890 MC in 340° of rotation, allowing the use of a small direct reading dial scale. Included in the tuner is one stage of i-f for any selected frequency, though normally supplied with a 195 MC i-f.

The first application indicates that the tuner will be used externally as a converter for existing VHF sets. The second application indicates that the same UHF tuner be conveniently installed on the TV chassis proper with the tuner working into the high VHF channels. Both of these applications are susceptible to spurious responses which are overcome by switching the VHF tuner to channel 8, 9, 10, 11, or 12, whichever is free of undesirable responses, and adjusting the i-f output trimmer control on the rear of the tuner accordingly. The third application indicates that the UHF tuner would have a 40 MC i-f output and would couple directly into a 40 MC i-f amplifier system. In this case, there will be two preselector stages used in the UHF tuner, or a total of three sections. The fourth application combines the UHF tuner with a compatible VHF tuner to form a compact and complete tuning unit.

The complete unit, Fig. 1, has the following controls on the front: station selector, fine tuning, off-on power and UHF-VHF antenna change-over switch, The overall dimensions of the cabinet are 8.125 x 5.75 x 4.5 in.

The converter rear view of Fig. 2 illustrates panel board connections for the UHF antenna, VHF antenna, and input to the VHF receiver. In cases where sufficient signal is available and the use of a UHF antenna is not required, it is necessary to place a short section of 300 ohm line between the UHF antenna and VHF antenna terminals. The i-f output trimmer adjustment for selecting the desired VHF channel and matching the output of the converter to the input of the VHF set is shown by the arrow.

Fig. 3 is a view of the UHF tuner removed from the chassis with all covers and shields in place.

Fig. 4 is a top view of the UHF tuner with the shields removed. Shown in this view are the preselector lines and the slider with their respective trimmers in place. Back of the line is the antenna coupling loop. Also shown is a portion of the cascode i-f amplifier tube.

Fig. 5, a bottom view of the UHF tuner with the shields removed, shows the trimmers, oscillator lines and tube. The shorting sliders are attached to a bakelite ring which is driven by means of a dial cord.

Drive Mechanism

One of the most important considerations of a UHF tuner is the drive mechanism. The drive mechanism must simultaneously tune two or more circuits. All shielding is completely silver-plated over copper. The cost of the drive must also be considered and should represent a small part of the total cost of the unit. An anti-backlash drive and speed reduction is simultaneously obtained by the use of a spring loaded dial cord around a molded bakelite ring to which the preselector and oscillator sliders are attached.

The line was shaped in a radius in order to gain compactness, as well as to simplify the slider and tuner drive mechanism. Tuning is accomplished by using silver-plated sliders having zero backlash. The sliders are noiseless during operation as well as operation after a long storage period of inactivity. These tests were performed on separate sound as well as intercarrier receivers. Fig. 6 is the circuit schematic.

The overall r-f circuit of the con-

Design of a Compact UHF Tuner

by a shorted transmis-

rectly into VHF receiver

verter consists of a stationary balanced transmission line type antenna coupling loop, a tunable preselector transmission line, and crystal mixer. The transmission line type of antenna loop is mutually coupled to a preselector line and this coupling is employed to correct the small variation of preselector Q with frequency to obtain a near constant loaded bandwidth. This is achieved by physically locating the loop closer to the preselector line at the high frequency end of the range. The oscillator and preselector lines are made of 0.25 in. wide curved parallel strips of silver-plated brass. Tuning by means of a parallel line of adjustable electrical length allows a large frequency range, simplicity of tuning, uniformity of tuning law which facilitates tracking, economy, and flexibility of design.

Due to the fact that the antenna coupling loop and the crystal mixer are placed at opposite ends of the transmission line, direct coupling between the antenna and mixer circuits allows the adjustment of input and output coupling to be essentially independent of each other. Making the output loaded bandwidth slightly greater at the higher frequencies compensates for the lower Q's obtained at these higher frequencies for a completely unloaded line.

Tracking is Simplified

The tracking problem is simplified by the employment of two trimmer capacitors on the preselector lines. One trimmer capacitor is used for setting the high frequency end and another trimmer condenser is used for setting the low frequency end of the range. This arrangement allows electrical tracking of the oscillator with the preselector circuits being a simple and positive alignment operation. The two trimmer adjustments are practically independent of each other. To tune the converter with a single control, it is necessary that the preselector circuit tune to a frequency which is higher than the local oscillator by a constant frequency difference equal to the VHF channel which is being used as the i-f. The preselector tracks the local

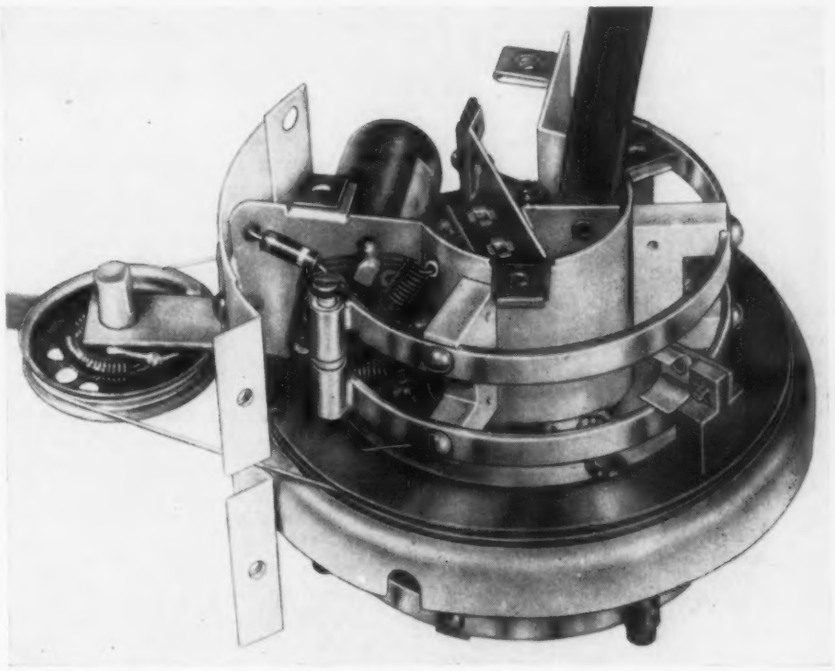


Fig. 5: Bottom view of tuner with shields removed shows oscillator lines, tube and shorting slide

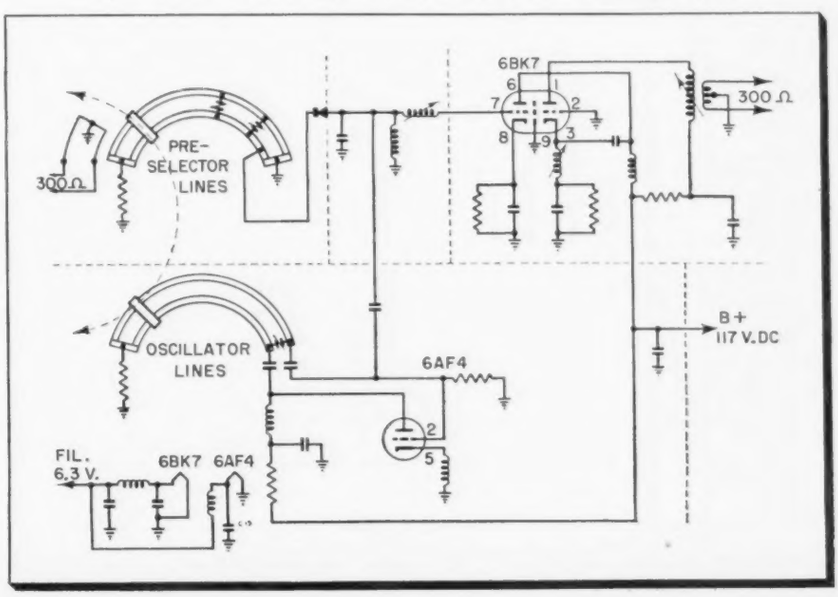
oscillator within a few MC throughout the band.

The trimmers are a special UHF balanced type which were developed especially for this type of tuner. All through the tuner design special emphasis has been placed on the fact that wide tolerances on materials and methods be incorporated without loss of tuner efficiency, and the elimination of engineering specifications which would place an imposition on production.

The preselector circuit is based on a halfwave transmission line developing an unloaded Q of 600 with complete absence of dead spots or spurious responses, and having a line characteristic impedance of 125 ohms. In covering this frequency range the line shorting slider has a

(*Continued on page* 76)

Fig. 6: Circuit of UHF tuner. Input and output coupling are independently adjusted



Checking

Dynamic Substitution Method produces ex-
New approach is applicable to simulation

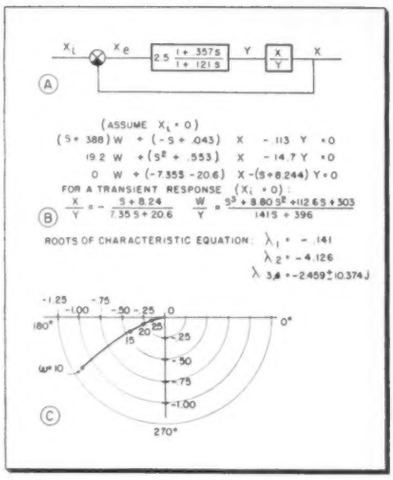

(ASSUME $X_i = 0$)
$(5+.388)W + (-5+.043)X - .113Y = 0$
$19.2W + (5^2+.553)X - 14.7Y = 0$
$0W + (-7.355-20.6)X - (5+8.244)Y = 0$
FOR A TRANSIENT RESPONSE $(X_i = 0)$:
$\frac{X}{Y} = -\frac{5+8.24}{7.35\,5+20.6}$ $\frac{W}{Y} = \frac{5^3+8.80\,5^2+112.6\,5+303}{141\,5+396}$
ROOTS OF CHARACTERISTIC EQUATION: $\lambda_1 = -.141$
$\lambda_2 = -4.126$
$\lambda_{3,4} = -2.459 \pm j0.374$
180°
0°
270°
ω = 10

Fig. 1: Diagram (a) and equations (b) for control system. Nyquist plot (c) of function X/X_0

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THE need for adequate verification of analogue computer solutions is obvious, but there is some question as to what is adequate and at the same time practical.

There are two systems of checking, complete and by parts. The latter consists of dividing the problem into sections and, if continued, finally becomes a check of the set-up procedure. In nearly all problems, however, these checks must be supplemented by a complete check.

Checking may be classed as static (i.e., time held constant) or dynamic. Static checking, though useful, is not complete and we are therefore primarily concerned with dynamic checking.

Linear systems are checked by two general methods, transient response and frequency response. The latter requires phase and amplitude data which are often available from stability analysis. Transient response may consist of a "zero damping" check, requiring that a parameter (such as "gain" in a control system analogue) be varied to achieve the check condition; or periods and damping may be evaluated, requiring computation of roots. It is customary to choose initial conditions and to analyze the results in order to provide a good check on each of the roots. There are cases, however, in which the effects of certain roots are difficult to observe accurately. A simple example is a fourth order equation with two negative real roots and a complex pair with negative real parts. The transient response is the sum of a "damped sine" and two simple "exponential decays." The result may be analyzed by measuring the period and attempting to draw an "envelope" and "center line" for the oscillations, and then evaluating these exponential curves. But if either of the real roots is relatively small, it is so "covered up" by the oscillations that accurate interpretation is virtually impossible.

An alternative is to compute the value of a variable for certain selected values of time and compare the results. Here, too, accuracy of results is greatly impaired if the complex exponential is the major factor in the transient. In higher order equations the difficulties are much greater. They may be overcome, however, by a method of checking which might be called Selected Root Transient Analysis. This method requires that the differential equations be solved, and that initial conditions be computed to result in a value of zero for all coefficients of the exponentials in the solution, excepting the one (or complex pair) to be observed. Thus the modes or roots may be analyzed separately and with no more difficulty than for a first or second order differential equation.

Checking Non-Linear Systems

Checking of non-linear systems has in the past consisted almost entirely of checking by parts, usually inadequate, or of step-by-step solution, often long and costly. As a result some work has recently been done in developing better methods. The substitution method has been used, but in its usual form does not check integrations. This has been combined with numerical integration (permitting larger steps than independent digital solution) but the resultant accumulative error is not easily evaluated.

A method we have called Dynamic Substitution has given excellent results with great economy of digital equipment and time, as compared with step-by-step checking. It consists essentially of a substitution check repeated at intervals sufficiently close for checking of integrations by differentiation, and statistical evaluation of errors. This method has a very important advantage in being easily applicable to simulation problems using actual equipment in connection with a computer. It may be used for part of a system and therefore applies in cases where checking by parts is adequate. Finally, if errors exist, they can be easily located.

Selected Root Transient Response Check

This technique is based upon the classical method of solving ordinary linear differential equations. Consider a force-free set of such equations expressed in operational notation as

$$A\,X = 0 \qquad (1)$$

where A is a matrix with n rows and n columns and each term of the matrix is a function of the differential operator, s, and X is a column vector in the n unknowns $x_1, \ldots, x_n$. The classical solution for equation (1) is

$$X = Z\,e^{\Lambda t} \qquad (2)$$

where Z is a matrix with n rows and m columns and $e^{\Lambda t}$ is a column vector corresponding to the m roots $(\lambda_1, \ldots, \lambda_m)$ obtained by setting the matrix A equal to zero and solving the characteristic equation of the system. The matrix Z is determined by the initial conditions imposed upon the system. Since the system is linear, its response to each characteristic root may be considered separately and then the superposition principle may be applied to obtain the final result.

Assume that a solution X corresponding to the root λ_v (i.e. $x_1 = z_{1v}\,e^{\lambda_v t}, \ldots, x_n = z_{nv}e^{\lambda_v t}$) is substituted into equation (1). Then in the matrix A, the operator s will be replaced by λ_v (call this matrix A_v) and the vector X will be replaced by the column vector $Z_v(z_{1v}, \ldots, z_{nv})$. Hence equation (1) becomes

$$A_v Z_v = 0. \qquad (3)$$

Since λ_v is a root of the matrix A, this homogeneous system will have a non-trivial solution. Then n−1 of the variables can be determined in terms of the remaining coefficient, say z_{rv}. Note that if z_{rv} is chosen to be zero,

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cellent results with substantial savings in time and material.

problems using actual equipment in connection with a computer

the column vector Z_v will be a null vector.

The Selected Root method consists of setting all the coefficients Z equal to zero except the column vector of the desired root. Then (n−1) coefficient ratios are determined from equation (3) (i.e. $z_{1v}/z_{rv}, \ldots, z_{nv}/z_{rv}$). After these ratios are established appropriate initial conditions are readily obtained. These initial values are set into the machine and a transient response is observed. Since the coefficients of all other modes are zero only the desired mode will appear. The damping and period (for complex roots) are easily verified. This procedure is repeated for each real root and each complex pair.

Simplifying Calculations

To simplify the calculations, the coefficient ratios should be determined in terms of the differential operator s. In control system problems, the ratios may be selected to correspond to previously determined transfer functions. Then s is replaced by the root that corresponds to the mode that is being checked. A complex root will, in general, yield a complex coefficient. Moreover, the conjugate root will yield a conjugate coefficient. Hence only one of the pair needs to be substituted into the ratios.

Figs. 1a,b show the block diagram and equations for a simple control system. As shown, this system has four roots, two real and two complex. The roots were substituted into the transfer functions X/Y and W/Y. From these ratios, three sets of initial conditions were determined. The transient response relationship is derived from the third equation in Fig. 1b, and does not represent the X/Y in Fig. 1a. Fig. 2 shows the response to an initial W. It is obvious that checking this response would be quite difficult. Figs. 3, 4 and 5 show the response to the calculated initial values. Here each response shows only one mode. Note also that different time scales are used.

In some problems, it is necessary to check a positive root. This mode can be checked by removing all initial conditions and putting the machine in operation. The initial conditions for other roots can then be calculated by the method previously discussed.

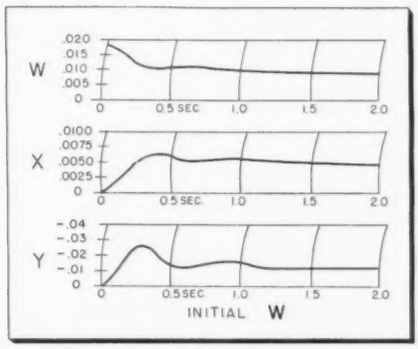


Fig. 2: System response to an initial W

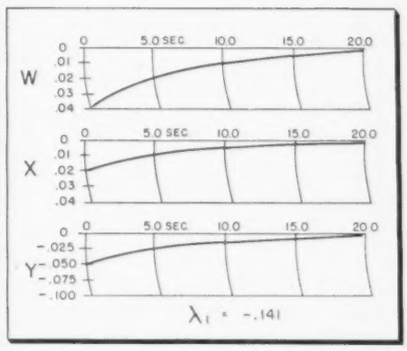


Fig. 3: System response to calculated initial λ_1

In many problems, a frequency response may be available or readily computed. Then the set-up shown in Fig. 6 may be used to determine the frequency response of the simulated system. Integrators 1 and 2 and Inverter 15 form a standard oscillator. As shown, a sine wave at a selected frequency is fed into the system being checked and the output is fed into Amplifier 8. By a suitable choice of input to Potentiometers 1 and 2 (as indicated by the dotted lines), the voltage contributed by these potentiometers to the output can be selected to have a phase shift that is in any of the four quadrants. The magnitude of the phase shift is determined by the potentiometer settings and the gains. The initial condition (I.C.) of the integrator is V volts, and the inputs to Inverters 15 and 16 are fed into unity gains.

The most satisfactory way to obtain zero output is first to adjust one potentiometer and the associated gain to get a minimum output. Then the other one is adjusted. This process is repeated with greater and greater sensitivity until a null is obtained. In practice only a few minutes are necessary to achieve the desired null.

It should be noted that the settings and gains do not depend upon the voltage, V. Hence for simple non-linear systems (those with rate or position limits), the simulation may be checked in the linear range by using a suitably small voltage. The check is completed by using large inputs and observing that the limits function properly.

Fig. 1c is a Nyquist plot of the transfer function X/X_c obtained by substituting $j\omega$ for s. The values for the frequencies, ω, are selected from a knowledge of the significant fre-

Fig. 4: System response to calculated initial λ_2

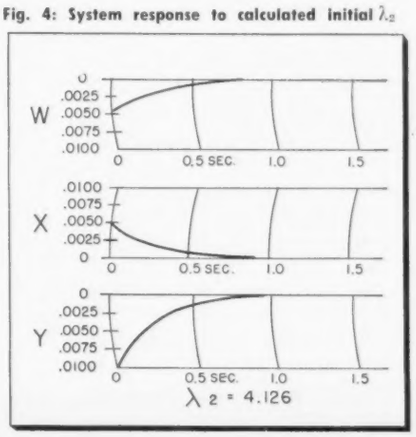
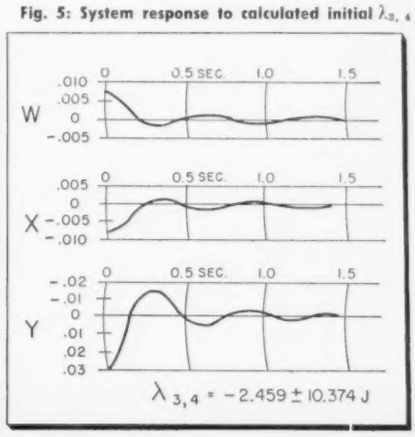


Fig. 5: System response to calculated initial $\lambda_{3,4}$



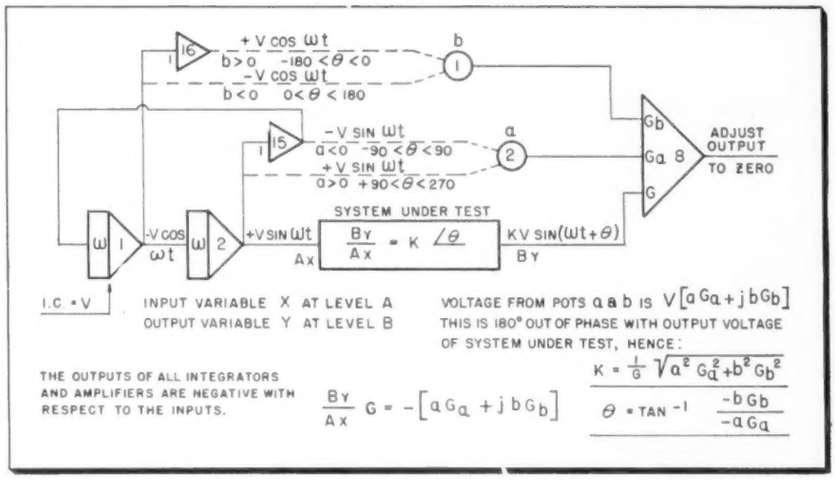

+V cos ωt
b>0 -180<θ<0
-V cos ωt
b<0 0<θ<180
-V SIN ωt
a<0 -90<θ<90
+V SIN ωt
a>0 +90<θ<270
SYSTEM UNDER TEST
ADJUST OUTPUT TO ZERO
-V cos ωt
+V SIN ωt
KV SIN(ωt+θ)
I.C. = V
INPUT VARIABLE X AT LEVEL A
OUTPUT VARIABLE Y AT LEVEL B
VOLTAGE FROM POTS a & b IS V[aGa+jbGb]
THIS IS 180° OUT OF PHASE WITH OUTPUT VOLTAGE OF SYSTEM UNDER TEST, HENCE:
K = 1/G √(a²Ga²+b²Gb²)
θ = TAN⁻¹ -bGb/-aGa
THE OUTPUTS OF ALL INTEGRATORS AND AMPLIFIERS ARE NEGATIVE WITH RESPECT TO THE INPUTS.
By/Ax G = -[aGa + jbGb]

Fig. 6: Set-up used to determine frequency response of the simulated system

quencies of the system. The results obtained from a frequency response check are superimposed on this plot.

Dynamic Substitution Check

In the dynamic substitution method, the problem is run so that all parameters and the available derivatives are recorded. The traces are then read at small time intervals. This work has been facilitated by using automatic data analysis equipment. Using a "Telereader," "Telecorder" and IBM reproducer, a punched card is obtained for each point. Then the values obtained are substituted into the original differential equations. To prevent the accumulation of small errors, integration rates are checked by differentiating. Most of the calculations will consist of algebraic operations or the solution of simple first order differential equations. The IBM 604 Electronic Calculating Punch is generally adequate for these operations. However, if a Card Programmed Calculator (CPC) is available it can be used to effect an appreciable saving in time.

Substitution in the original equations should, theoretically, yield identities. However, there will of course be errors. If there are no mistakes, the principal source of errors is in converting from REAC voltages to trace deflections. For example, assume that the equation for a high speed servo is

$$x = 100\,(x_i - x) \qquad (4)$$

where the variables are expressed in terms of trace deflection (in divisions). Then an error expression for this equation would be

$$e = x - 100\,(x_i - x) \qquad (5)$$

If the error in reading x is −0.1 division and the error in $(x_i - x)$ is +0.1 division then e = −10.1. On the other hand if the given equation were

$$\dot{x} = x_i - x \qquad (6)$$

then $e = \dot{x} - (x_i - x)$ and for the same reading errors, e = −0.2. Hence, by themselves, large or small errors do not indicate if a correct or incorrect solution has been obtained without a detailed analysis of each calculation.

Assume a variable X is read on a recorder trace and the true value of the reading expressed in terms of trace deflection is X_d, but the actual deflection is $X_d + \delta$. Then δ will be a chance variable, and it will be assumed that δ has the following properties:

1) δ has a normal distribution
2) The mean of the distribution is zero and the standard deviation is σ
3) δ is dependent of X_d, implying that the recording is linear.

Now consider the simple operation of summing two variables, e.g., assume the equation is

$$AX_d + BY_d = 0. \qquad (7)$$

If the unknowns are read from recorder traces, then substitution in equation (7) will yield an error

$$e = A(X_d + \delta_1) + B(Y_d + \delta_2) \qquad (8)$$

where δ_1 and δ_2 are chance variables (both satisfying the assumptions given above) corresponding to the two recordings. From equation (7) it follows that equation (8) can be reduced to

$$e = A\delta_1 + B\delta_2 \qquad (9)$$

Then from probability theory it follows that e is a chance variable that has a normal distribution with mean zero and variance $\sigma^2(A^2 + B^2)$. It should be noted that A and B include not only given constants but also voltage level factors and recorder gains. Since the latter may vary during the run, some analysis would be needed to ascertain the correctness of a given solution. Hence, by itself, this calculation is not very satisfactory.

However, if the error, e, is divided by the standard deviation of the distribution $r_i = \sigma\sqrt{A^2 + B^2}$, then

$$E = e/r_i. \qquad (10)$$

This new chance variable E will have a normal distribution with mean zero and variance one. Because the variance will always be one, this chance variable E may be called a normalized chance variable and r_i will be called the normalizing factor.

Therefore in checking a given equation, the function E is calculated for each point that is read from the traces. Let the number of points considered be n; then there will be n values of E $(E_1, \ldots, E_r, \ldots, E_n)$. These values are a sample from a normal distribution. If the sample is large enough, it will exhibit the same properties as the distribution. Consequently, it will have a mean that is close to zero, a standard deviation of approximately one; about 86% of the values E_r will be between ±1, and about 95% will be between ±2. The primary criterion that is used to determine if the solution is correct is mean of the sample. $m = \left[\sum_{r=1}^{n} E_r\right]/n$

If the magnitude of the mean |m| exceeds a specified value, m_0, the solution will be considered to be in error.

Preliminary Measurements

Obviously it is desirable to choose σ and m_0 as small as possible for this means that smaller errors will be detected. Preliminary measurements on the Brush 6-Channel Recorder indicate that σ lies between 0.1 and 0.2 divisions and m_0 should be about 0.1. Furthermore it appears that errors as low as or less than 5% can readily be detected.

Next, three types of equations will be considered. It should be remembered that variables will always be expressed in terms of trace deflection. First this method will be applied to two equations that were previously used. For equation (4), if $\sigma = 0.1$ then $r_i = 14.1$ and (for the specified errors) E = 0.72. In equation (6), $r_i = 0.17$ and the reading errors yield E = 1.2. Thus clearly this method properly identifies the correct solution. Second, consider the problem of checking an integration constant. Let the equation be

$$x = A_0 \int^t y\,dt \qquad (12)$$

where the unknowns are expressed in terms of recorder trace deflection. In many problems, especially those

(*Continued on page* 86)

Mobile Radio Looks to UHF

FCC-authorized transmitters now top one-third million mark. Future expansion in 450—470 MC band expected

By ROBERT E. TALL

Associate Editor, Mobile-Safety Radio Reports, Telecommunication Reports
1208-1216 National Press Building, Washington 4, D. C.

STILL racked by growing pains but conscious of the tremendous role for which it is destined, mobile radio—already a multi-million dollar investment—is swiftly blanketing the U. S. with an ever growing myriad of whip-lash antennas.

Demand for this rapid communication facility has, from a relatively slow beginning in the 1930's exploded throughout the country, as shown in the growth curve of Fig. 1. The supply of the newest types of equipment for mobile radio systems just barely keeps pace with the mushrooming demand. Today there are more than a third of a million radio transmitters authorized by the FCC for use by public safety, industrial and land transportation organizations—more than 70 times as many as are being used in the broadcasting industry.

Public Safety Field Leads

Actually the field is expanding so rapidly that statisticians are at a loss to keep a running account of the number of transmitters now in use in mobile radio networks, but in one of the latest summaries, Col. Edwin L. White, Chief of the FCC's Safety & Special Radio Services Bureau, which regulates the field, stated that the public safety field alone, which is perhaps one of the best known of the non-broadcast services, comprises more than 10,000 separate radio systems. The most extensive radio user group in the public safety field, the police radio service, has over 6900 communications systems involving between 50,000 and 60,000 transmitter and receiver units.

An even more striking example is in the taxicab industry, where the service has grown from a single base station and two mobile installations in 1946 to more than 3000 base stations and well over 63,000 mobile installations at the end of 1951.

In the public safety services, in addition to the systems devoted to police operations, there are almost 4000 other mobile radio networks authorized in the far-flung operations of conservation departments, state and local highway systems, fire departments and protection services. Although no actual count is being kept on the number of transmitters making up each of these systems, the Commission's annual report for 1951 estimated that with far fewer networks in operation than there are today, there were more than 80,000 individual radio transmitters authorized in this single field at the end of the latest fiscal year.

Industrial Stations

At the same time, there were eight classes of industrial stations with 9500 authorizations involving the use of 6500 fixed transmitters and 64,000 associated mobile units, and almost 5000 authorizations in the land transportation services, with approximately 3700 fixed transmitters and 75,000 associated mobile units.

The controlling factor in the number of radio systems that can be accommodated in any one territory is the radio frequency spectrum, which is swiftly becoming congested in the U. S. Painstaking care must be exercised in the licensing of each new network to insure that the new system will not interfere with established facilities. With limited congressional appropriations, overburdened FCC staff members, unable to cope with the avalanche of incoming applications for new, modified or additional radio facilities under present licensing procedures, have reported that at the beginning of June, there was a backlog of more than 10,000 requests awaiting disposition.

To take some of the load from the Commission, national organizations have sprung up among the various industry groups to coordinate the use of radio in the best interests of each industry. Personal company interests are being sacrificed generously to insure that each potential

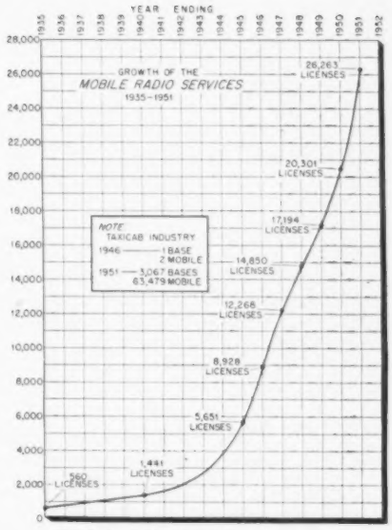


Fig. 1 Growth of mobile radio in U. S.

radio user is given a fair opportunity to make use of radio. Representative of the groups putting forth much of the time, talent and money are: American Petroleum Inst.; National Committee for Utilities Radio; Assoc. Police Communications Officers; International Municipal Signal Assoc.; American Taxicab Assoc.; Assoc. of American Railroads; National Assoc. of State Highway Officials; National Rural Electric Cooperatives Assoc.; and IRE. Working closely with these rganizations are other groups in the aviation and marine fields: Radio Technical Commission for Aeronautics; and National Assoc. of State Aviation Officials.

In addition, many of the larger radio equipment manufacturers are contributing extensively to the general knowledge by freely sharing the results of their research and development activities with the equipment users.

Present Bands Crowded

With the crowding of presently used frequency bands for mobile services, particularly the 25-50 MC and 152-162 MC bands, the industry has been alert to the possibility of extending mobile radio operation to higher frequency regions. Also, technical advances in equipment design are making it possible for radio systems to operate with less frequency space between them.

One of the nation's outstanding authorities on mobile radio, Dr.

(*Continued on page* 82)

Boroncarbon

Industrial Preparedness units suitable for mass

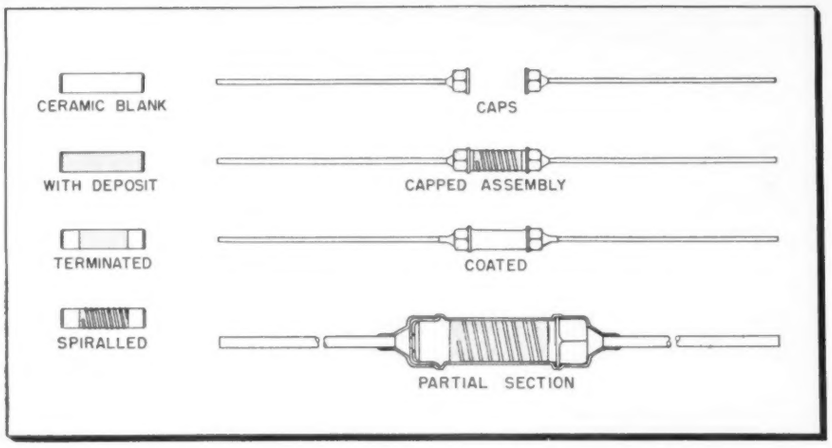


Fig. 1: Principal steps in resistor construction includes deposition of boron-carbon film, application of terminating bands, spiralling to obtain resistance value, applying terminal caps and coating.

By GEORGE KENDE, International Resistance Co., Philadelphia, Pa.

BORONCARBON resistors are a modified form of the general class of pyrolytic carbon resistors, more commonly referred to as deposited carbon resistors. Deposited carbon resistors were first produced commercially in Europe, principally Germany, beginning approximately 1928. Their production and application in this country proceeded at a relatively slow pace until the beginning of World War II when military requirements for stable non-wirewound resistors, possessing stability characteristics better than those of composition resistors, became manifest. Considerable research and development work to meet this need was carried on by the Bell Telephone Labs., resulting in improved knowledge regarding the process and improved manufacturing techniques. Development of the electronic art and electronic applications during the period 1946 to 1951 in the field of military and commercial instrumentation, and the consequent demand for resistors meeting more exacting standards of stability and overall performance, further stimulated manufacturer and consumer interest in deposited carbon resistors, resulting in a growth of production facilities. However, for certain applications the relatively high temperature coefficient (high when compared to most wirewound types) proved a deterrent to more widespread use.

At the National Electronics Conference in Chicago, Sept. 27, 1950, Bell Labs. announced that the codeposition of carbon and boron results in a material reduction in temperature coefficient to the point where such composite boroncarbon resistors have temperature coefficients comparable to many wirewound types.

It is of historical interest to note that the action of boron on carbon was investigated at the laboratories of the General Electric Co., Lynn, Mass., during the period 1909 to 1912. Reference is made in these early studies to "boronized carbon," "boroncarbon alloy," and to the marked effect of boron on the temperature coefficient of carbon. Apparently, however, the implications of this early work on boroncarbon were forgotten and not utilized during the following 30 or more years.

Development Background

As a result of the Bell Labs. announcement in Sept. 1950, International Resistance Co. started an intensive development program aimed at the reduction of temperature coefficients of deposited carbon resistors, while maintaining or improving other performance characteristics. Rapid strides were made in this direction during the latter part of 1950 and early in 1951, and as a result of this progress the Signal Corps, through the Industrial Services Div. of the Signal Corps Procurement Agency, awarded to IRC a contract, sponsored by the Signal Corps Engineering Labs., for an Industrial Preparedness Study on boroncarbon resistors. This study included the development of mass production techniques and equipment, and qualification testing to military specification MIL-R-10509. That phase of this contract pertaining to the production of ½-watt resistors is now complete and the following illustrations are intended to show the general constructional details and performance characteristics of this resistor.

General constructional details are shown in Fig. 1, corresponding to the principal steps in the manufacturing operation as follows:

1. Deposition of the resistance film.
2. Application of terminating bands.
3. Spiralling the resistance film to obtain the required value of resistance.
4. Applying terminal caps.
5. Applying protective coatings.

Boroncarbon units are distinguished by final coating of blue, while deposited carbon units, of identical size, are given a brown finish. For the ½-watt unit, ceramic dimensions are ⅛ in. diameter x $^{17}/_{32}$ in. Finished dimensions over terminal caps are $^{5}/_{32}$ x $^{9}/_{16}$ in. After application of terminating bands, units are baked in a conveyor oven for two hours at 230°C, and then processed in a continuous manner through automatic test equipment which sorts them according to resistance value into 5% categories. Spiralling units are provided with automatic resistance control which in effect continuously measures the resistance of the unit while it is being spiralled and, at the desired point, stops the spiralling action to an accuracy of 2%. Resistors are produced to a 1% tolerance by a subsequent adjusting procedure. Terminal caps are silver plated. Testing before application of protective coat, the application and baking of protective coat, and testing after baking are arranged as a continuous automatic operation with 100% check on resistance value at the beginning and end of the process.

Load Characteristics

Load characteristics are shown in Fig. 2. The letters BOC indicate the ½-watt boroncarbon resistor, while DCC indicates the IRC deposited carbon resistor. Composition resistors A and B, whose charactistics are shown for comparison, represent average performance characteristics

Resistor Characteristics

Study for SCEL leads to development of 1/2-watt production and having extremely stable characteristics.

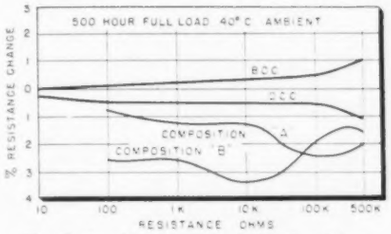


Fig. 2: Load test characteristics of resistors

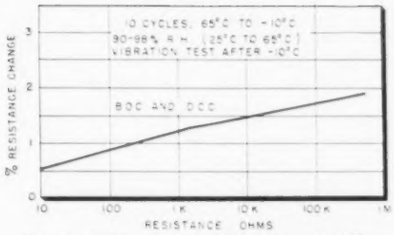


Fig. 3: Moisture test resistor characteristics

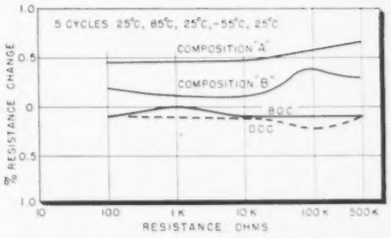


Fig. 4: Resistor temperature characteristics

of two prominent makes of composition resistors. The value of resistance change increases with resistance value to a maximum of 1% for boroncarbon, slightly more for deposited carbon. The direction of change is positive for boroncarbon, while it is negative for deposited carbon. MIL-R-10509 specifies a maximum permissable change of 2% on the resistance change test. Maximum voltage specified for type BOC (½ watt) is 350 v.

Moisture Cycle Test

Results of moisture cycle test are shown in Fig. 3. The performance of boroncarbon (½-watt in all tests) and deposited carbon are equal in this respect and again show an increasing resistance change tendency with increasing resistance value. The maximum change, at 0.5 megohm, is 1.9%. MIL-R-10509 allows a maximum of 5% change on this test, which consists of ten 24-hour cycles, each cycle containing conditions of 90 to 98% relative humidity, temperature variation from 65°C to —10°C, and each cycle containing a period of vibration testing.

The effects of temperature cycling are shown in Fig. 4. It is seen that boroncarbon performance here is slightly better than deposited carbon, maximum resistance change being approximately 0.15%. MIL-R-10509 allows a maximum change of 1%. The temperature cycle on this test consists of five cycles, 85°C to —55°C.

The effect of soldering is shown in Fig. 5. Test conditions consist of three seconds immersion at 350°C to a point within ⅛ in. of the resistor body. When subjected to this test, boroncarbon resistors are seen to change a maximum 0.12% in resistance, the direction of change being always positive.

Fig. 6 shows measurements of temperature coefficient for boroncarbon and deposited carbon, and indicates the relative position of temperature coefficients of resistance wire types commonly used in precision wirewound resistors. Boroncarbon resistors with values up to 500 ohms can be supplied with coefficients of less than 100 parts per million per °C; values between 500 ohms and 25,000 ohms to an average coefficient of 100 ppm; values over 25,000 ohms show increasing temperature coefficient, reaching a value of approximately 180 ppm at 0.5 megohm. Comparison of curves for deposited carbon and boroncarbon indicates that in the lower and medium range the use of boroncarbon against deposited carbon effects a reduction in temperature coefficient of approximately 3 to 1, while in the higher range, 0.5 to 1 megohm, the reduction in temperature coefficient is of the order of 2 to 1.

Fig. 7 shows frequency characteristics of boroncarbon and deposited carbon resistors compared with the average of three manufacturers' composition resistors, indicating a considerable margin of performance in favor of boroncarbon and deposited carbon. Boroncarbon and deposited carbon are shown by solid lines, there being no difference in performance between boroncarbon and deposited carbon in this respect.

Short Time Overload

Fig. 8 shows the effects of short time overload, consisting of the application of 250% of rated voltage for five seconds. Performance of bo-

(*Continued on page 75*)

Fig. 5: Effect of soldering on resistance

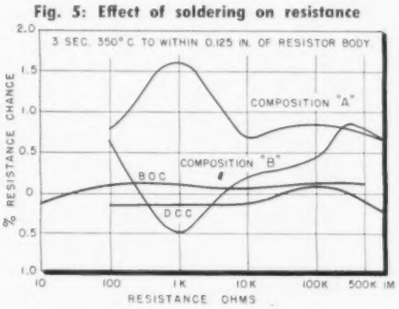


Fig. 6: Temperature coefficient measurements

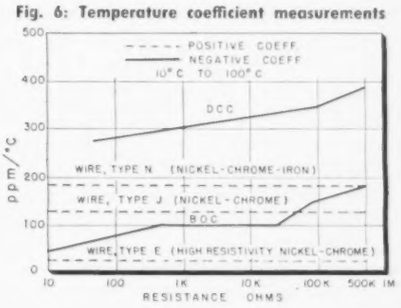


Fig. 7: Frequency test resistor characteristics

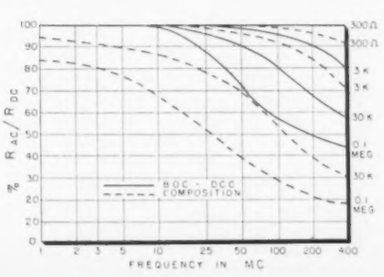
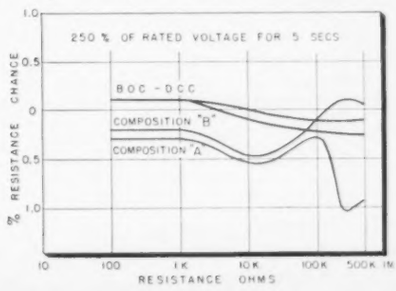


Fig. 8: Short-time overload characteristics



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Simplified Remote Control for Tape Recorders

HENRY O. WORTHING, WMSC, Glens Falls, N. Y.

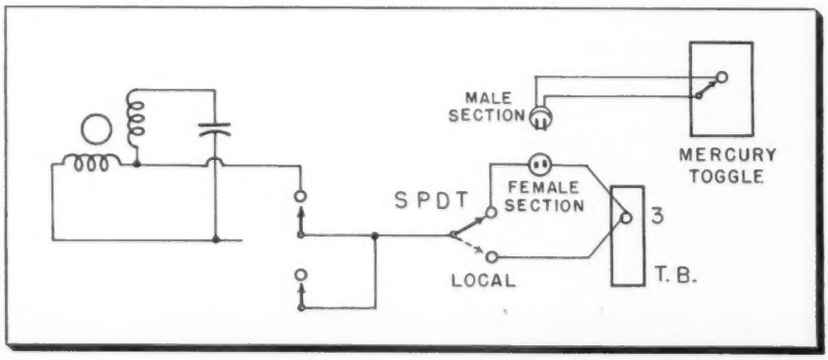
INASMUCH as we operate with a small announcing staff, our tape recorders must carry a greater than normal share of the work in the studio and, when the occasion demands, for nemo recordings.

When we acquired our two Magnecord PT6-A units, it was necessary to locate them so as to be accessible to the announcer operating the control console and this resulted in a very crowded control room. It was decided to rack mount and control the tape mechanisms from the control console, but due to the need of these same recorders for nemo work no permanent connections could be made if they were to be readily removable from the rack.

We mounted on the front panel of each PT6-A, a single pole, double throw switch, just below, and slightly to the left of the rewind position of the control switch. On the power terminal strip at the back of the PT6-A, terminal #3 is the common ac input to the switch and the motor fields. This line was cut and the switch side connected to the common terminal of the added SPDT Local-Remote switch. (see diagram); the terminal side of the open line 3 was connected to one of the terminals of the "Local-Remote" switch.

The other terminal of the "Local-Remote" switch was connected to one side of the female section of a round rubber covered ac connector of the sewing machine type. The other side of this connector section was returned to terminal 3 of the power terminal strip. These connector plugs have a rubber cap which can be forced into a convenient hole on the back of the PT6-A and need no further fastening.

"Local-Remote" control circuit for semi-portable Magnecord PT6-A studio installation



$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

Reverberation Effects by Tape Recorders

JOHN GORT, KOPR, Butte, Montana

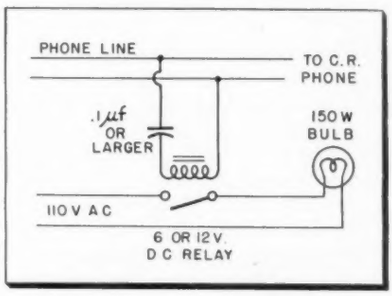
AFTER trying the idea described in "Echo Effects Produced by Splitting Tape" (TELE-TECH, Nov. '51, page 54), we found that the problem of splitting the tape and patching it back together became annoying. Consequently, we devised another method.

At KOPR, there are three recording units which are operated as follows: The line or lines on which echo effects are desired are recorded simultaneously on two recorders. However when the tape is cued in for playback, one tape is backed off 1 to 1½ in. more than the other. With the third machine running in the record position, the other units are switched on. If one of the playback units runs a little faster than the other, it can be corrected with a slight pressure on the offending supply reel. This results in an echo tape on the third machine and no splitting or patching is required.

Visible Phone Indication

BILL GORDON, Chief Engineer, CJDC, Dawson Creek, British Columbia, Canada

HERE is the control room visible phone indication circuit which is in use at CJDC. It can be used on either dial or receiverlift phone systems. Tension on the relay is released until the relay operates when



Relay and condenser connection to phone provides visible indication of calls

the phone is rung. Most phone companies use 24 or 48 volts ac for ringing and the relay can be adjusted until the armature vibrates and makes contact. The size of the condenser is not too critical but has to supply enough voltage to activate the relay and yet not so big that it causes the phone to be inoperative. We use a 150 watt bulb which flashes when the phone is rung.

A Universal Input System

R. S. HOUSTON, Chief Engineer, KNBZ, La Junta, Colo.

TO promote efficient operation with non-technical personnel, a system was needed to allow any mike to be plugged into any piece of equipment. The range of inputs runs from balanced, low impedance to unbalanced, high impedance. Microphones originally intended to go with only one piece of equipment, have the same variable circuitry.

All cables were fitted with standard three-prong plugs, and inputs were standardized on the amplifiers. In the case of the unbalanced input, one of the wires from a balanced cable was shorted to ground at the input plug. This completed the circuit from the microphone. Conversely, in the case of an unbalanced mike running into a balanced input, one of the cable wires was

norted to ground on the mike plug, nus completing the input circuit. For the unbalanced mike to work nto the unbalanced input, it was necessary for the same set of pins o be shorted; i.e., for the same wire n the cable to be grounded at both nds. Otherwise the signal will be horted out at one end. It is necesary, also, for the extension cords to have the proper polarity on the lugs at each end.

The only unit which dictated which wire should be shorted to ground was a remote amplifier with a three-position mixer. This has an unbalanced input using "T" faders, and the common wire was grounded. Thus, all plugs were made to correspond to this type of wiring. The possible combinations now for this system are: low impedance balanced or unbalanced to low impedance balanced or unbalanced; low impedance balanced or unbalanced to high impedance unbalanced. In the latter case, the mike was run directly to the grid. There is no loss in quality this way, and the loss in gain can usually be compensated for by the reserve gain present in most amplifiers. With all combinations, the extensions may be used without adapters or any special treatment.

A Clock-Timed Remote Control System

JAMES F. SMITH, KADA, Ada, Oklahoma

AT KADA the Magnecorders run an average of 3 hours daily with delayed net and tape programs. The tape machines are rack mounted some distance from the console, so a remote start-stop system is necessary. This is provided by relays "I, J, K."; DPST 6 v. relays are used. Coils of I and J are series connected, since the dc supply is 12 v. dc. Relay K has a series dropping resistor. It is necessary, for present operation when transcribing, to keep the B plus open until the Puller is started —to prevent burning the tape with the bias and erase voltage.

The diagram shows the changes in the PT6-AH, the dotted lines being breaks in the original connections. A four pin Jones plug makes connection to the relay so the PT6-AH can be removed for servicing. Since most network programs start on the hour, quarter hour or half hour—just when the operator is in the middle of running a fifteen second TX, queing up a theme, answering the phone and discovering the Format for the next program is missing from the book—too many tape programs were getting a delayed start or are missed entirely.

It was decided that a clock timer was needed. We used the Telechron Model C28-G4, which has 48 tabs, each giving a fifteen minute period. If 30 minutes are needed, two adjacent tabs are pulled, etc. It is possible to set up all the recording periods for a 12 hour period, at one time, with the assurance that, if all connections are made, the Puller will start on time. It is necessary to set the clock ahead about 30 seconds.

The clock at KADA, during the first 5 weeks, started a tape at exactly 9:44:36 each morning and stopped it at 10:29:57 until a power interruption slowed it a few seconds. The clock can be easily installed. The only precaution required is that it not be installed close to the recording heads, since there is considerable ac field around the clock. Originally our clock was at the top of the rack but caused so much hum when No. 1 Puller was playing back, that we moved it underneath the lower PT6-R Amp.

Maintaining Directional Pattern While Erecting Adjacent Tower

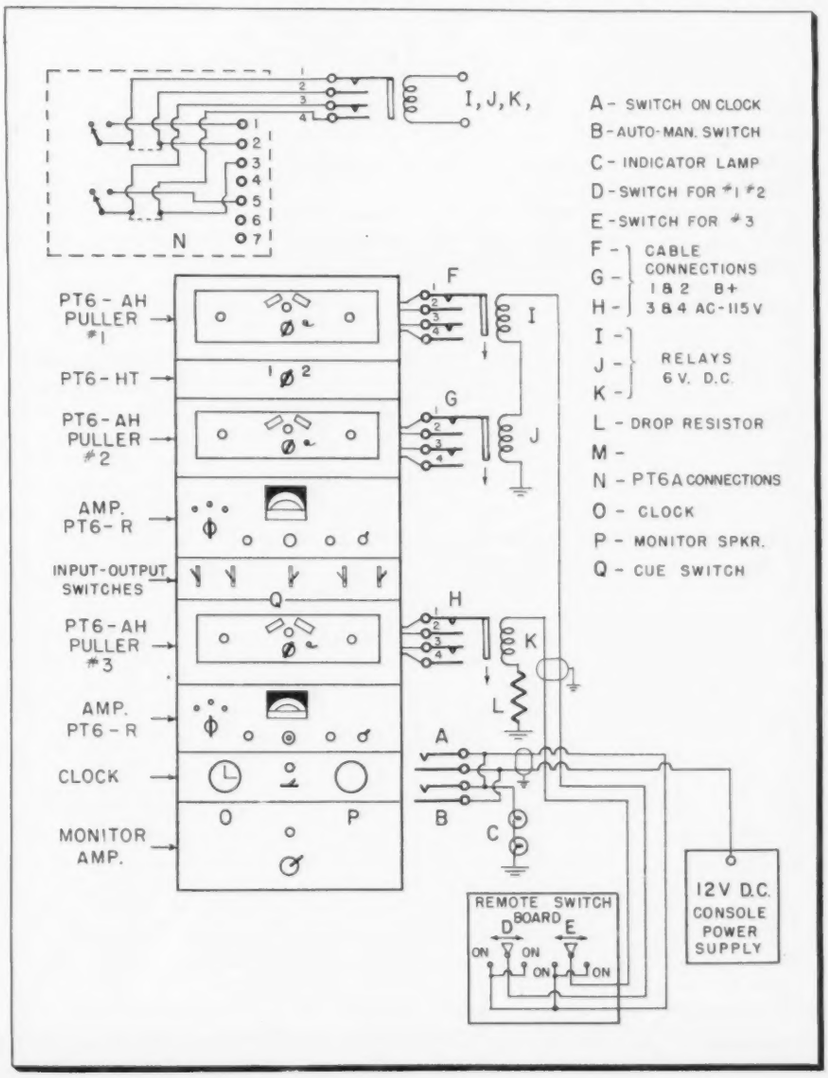
L. L. DAWKINS, Ass't. Chief Engr., WPTF, Raleigh, North Carolina

EArly in 1949, believing that a CP for television would be awarded to us, we "jumped the gun" and constructed a new tower for AM, FM and TV. A Blaw-Knox H-40 tower was selected to support a four section, heavyduty FM pylon and a three bay Super Turnstyle to provide an overall height of 525 ft. This tower was erected approximately 250 ft. from the 370-ft. 50-kw daytime radiator of a two-element, directional array. This note deals with problems involved in maintaining directional monitoring points within legal tolerance while the patterns were being upset daily due to the nearby growing steel structure.

We encountered no particular difficulty until the 100 ft. mark was reached on the new tower. During

(*Continued on page* 92)

Rack mounting layout for two Magnecord PT6-A recorders and amplifiers with auto time control



Wideband

Featuring novel tank used for tuning; plates

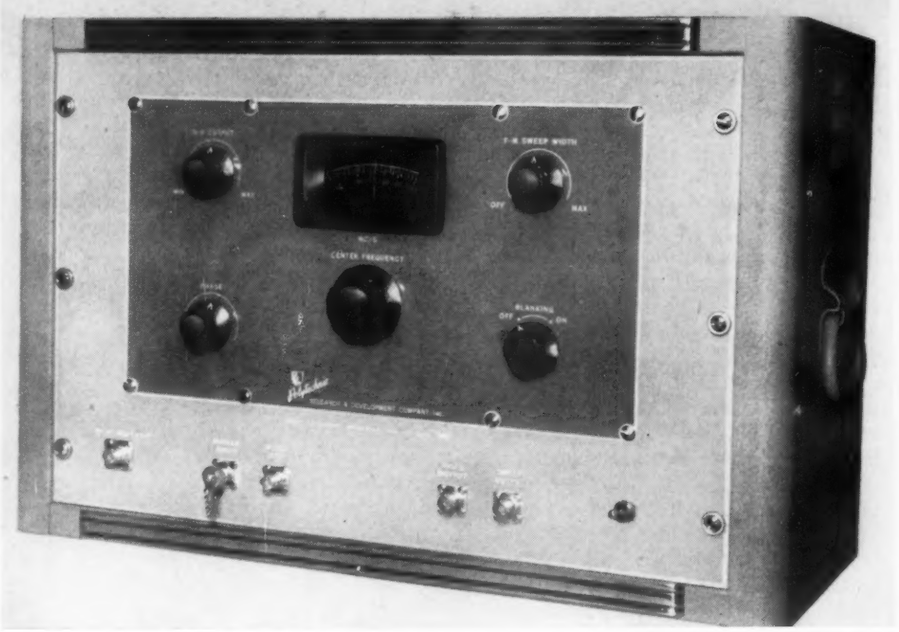


Fig. 1: PRD Type 907 wideband sweep generator covers the frequency range of 35 to 900 MC

By HERBERT A. FINKE and FRANK BLECHER
Polytechnic Research & Development Co.
202 Tillary St., Brooklyn 1, N. Y.

THE extension of TV service to the UHF band has developed a need for wideband equipment. This paper describes a fundamental sweep generator, shown in Fig. 1, that covers the range from 35 to 900 MC. The unit features a novel tank circuit design that permits a 30 to 1 tuning range with high output available at all frequencies. A resonant vibrating reed provides the necessary frequency modulation.

Fig. 2 presents a diagram of the r-f output and frequency sweep available at all center frequency settings of the oscillator. The instrument's performance with regard to non-linearity of sweep and level of undesired amplitude modulation over the frequency range is illustrated in Fig. 3. Because of the very low residual AM modulation, the sweep generator is ideally suited for aligning r-f and i-f amplifiers. In the UHF region, over 30 MC of sweep width are available. The large output voltages from the generator are particularly useful when working with passive elements. By means of a cut-off attenuator, the output is continuously adjustable to a minimum of 10 μv.

In order to facilitate visual alignment, a sinusoidal sweep voltage is provided for horizontal deflection of the oscilloscope. In addition, the sweep oscillator is blanked in order to remove the response pattern due to the return trace, and to produce a zero base line on the oscilloscope.

As shown in Fig. 4, the generator is basically a grounded grid Colpitts oscillator whose resonant circuit consists of the interelectrode capacities of the 6F4 acorn triode and a variable inductance which is connected between the plate of the tube and ground. The conventional method of designing an oscillator which covers the frequency range from 200 to 900 MC is to use resonant elements in the form of a transmission line. However, oscillators operating at frequencies below 200 MC perform most efficiently with lumped inductance. Therefore, a combination of transmission line and lumped inductance tuning would be very appropriate for a broadband oscillator. A novel mechanical tuning arrangement was designed which permits optimum performance over the entire frequency range without requiring range switching.

As shown in Fig. 6, a transmission line in the form of a thin metal strip mounted above the metallic ground plane is connected between the plate of the oscillator tube and ground. The effective length of the transmission line is varied by changing the position of a sliding contact which shorts the transmission line to the ground plane.

By changing the position of the sliding contact over this length of transmission line, it is possible to vary continuously the oscillation frequency from 900 to 150 MC. At a point on the line corresponding to oscillations at approximately 150 MC, a spiral lumped inductance is connected between the transmission line and the ground plane. The effective length of this inductance is varied by changing the position of a centrally driven short circuit, as indicated in Fig. 6.

For frequencies between 900 and 150 MC, the contact arm on the spiral inductance is fixed in position at the junction of this inductance and the transmission line. When the sliding short on the transmission line has moved past this junction point, the two shorts are effectively in parallel. As the sliding short on the transmission line moves further away from the junction, its short becomes less and less effective and can finally be completely removed. The short on the spiral inductance then starts to move and continuously reduces the frequency to 35 MC. The Geneva wheel and lock ensures that this short starts to move at exactly the right instant.

Waveguide Attenuator

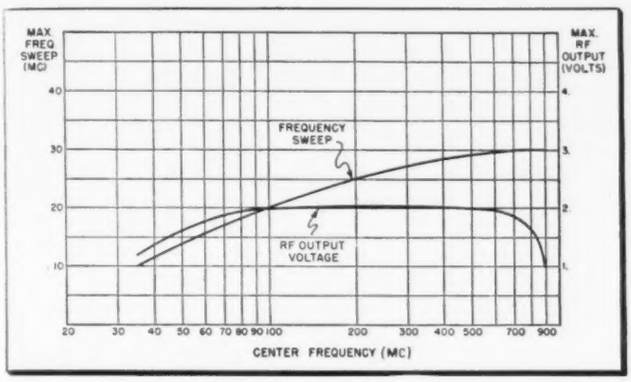
R-F output power is coupled from the sweep generator by means of an attenuator of the waveguide beyond cut-off type, mounted near the plate of the oscillator tube. This attenuator produces approximately 32 db attenuation for every cut-off tube diameter that the pick-up loop is moved. A small capacity "hat" is mounted on the end of a resistive pick-up loop, and is arranged so that it can be brought close to the plate of the oscillator tube. This ensures a maximum output of at least one volt into 75 ohms over the entire frequency range of the generator. The attenuator permits continuous adjustment of the output voltage from one volt to 10 μv into 75 ohms at all operating frequencies.

The resistive pick-up loop provides a low vswr source impedance for the sweep generator at all frequencies.

FM is accomplished by varying the capacity between the high impedance plate end of the transmission

Sweep Generator for VHF & UHF TV

circuit, instrument covers 35 to 900 mc range. Shorted transmission line mounted at end of vibrating reed provide frequency modulation



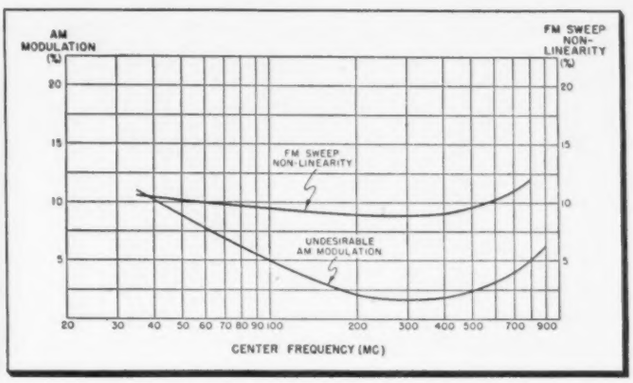


Fig. 2: (l) Sweep and r-f output at center frequencies. Fig. 3: (r) FM sweep non-linearity and undesirable AM at maximum sweep

line and ground. A set of capacitor plates mounted at the end of a vibrating resonant reed varies this capacity sinusoidally with time. This set of plates vibrates in mesh with two other fixed sets of capacitor plates, one mounted to the plate end of the transmission line, and the other set grounded. The mechanical arrangement is illustrated in Fig. 6. In order to maintain the frequency deviation as constant as possible over the entire frequency range of the generator, the vibrating set of plates is ganged to the center frequency control shaft.

A sinusoidally vibrating reed has several advantages over other methods of frequency sweeping. By employing a sinusoidal horizontal deflecting voltage for the oscilloscope, very good sweep linearity is obtained. The sweep width is most readily varied by changing the amplitude of vibration of the reed. Change in the sweep width has negligible effect on the center frequency of the sweep generator. Practically no microphonic AM is apparent—even at very small sweep widths where microphonic effects are usually noticeable. This is due partly to the fact that small frequency sweeps are obtained with very small amplitudes of reed vibration.

Oscillator Shielding

Thorough shielding of the oscillator is provided so that radiated or spuriously conducted leakage is kept to a very low level. All power supply leads are thoroughly filtered, and the frequency control shaft which is made of bakelite, is brought through a metallic cut-off tube to the front panel.

Several problems are encountered in designing an oscillator for this wide band. For any length of transmission line, there is a multiplicity of modes at which the 6F4 tube may oscillate. The tube can oscillate at any frequency for which the length of transmission line is resonant in either the fundamental or a higher mode. The circuit, though, will oscillate preferentially in the mode for which the difference between the available negative conductance and the positive conductance losses is the greatest.

As indicated in Fig. 4, the resonant circuit of the oscillator is shunted by the grid circuit loading and the plate resistance of the oscillator tube. The grid circuit loading is due to cathode current flow and to transit time effects. It is desired that the circuit oscillate only in the quarter wavelength mode. This is the only pos-

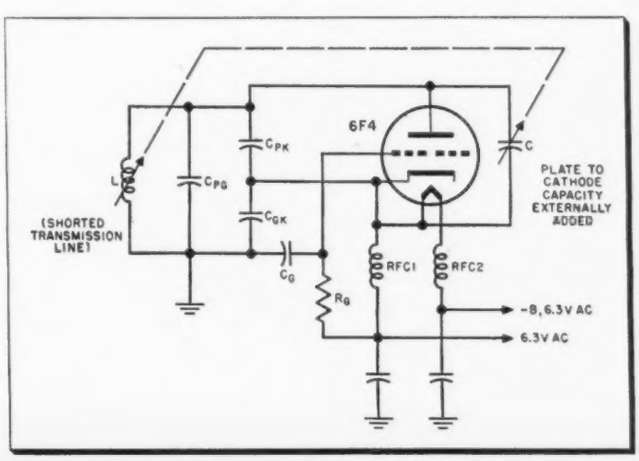
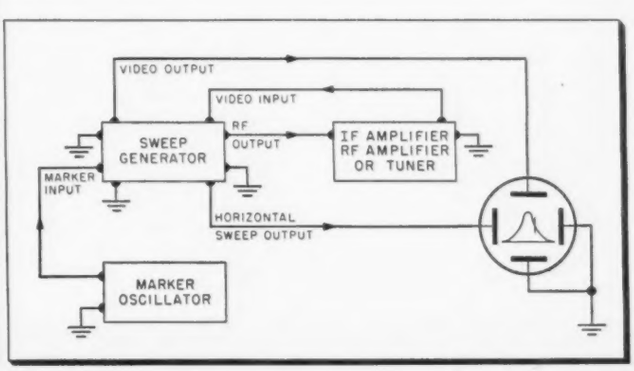


Fig. 4: (l) Schematic of grounded-grid Colpitts oscillator. Fig. 5: (below) Set-up used to determine frequency response of a two terminal pair network



SWEEP GENERATOR (Continued)

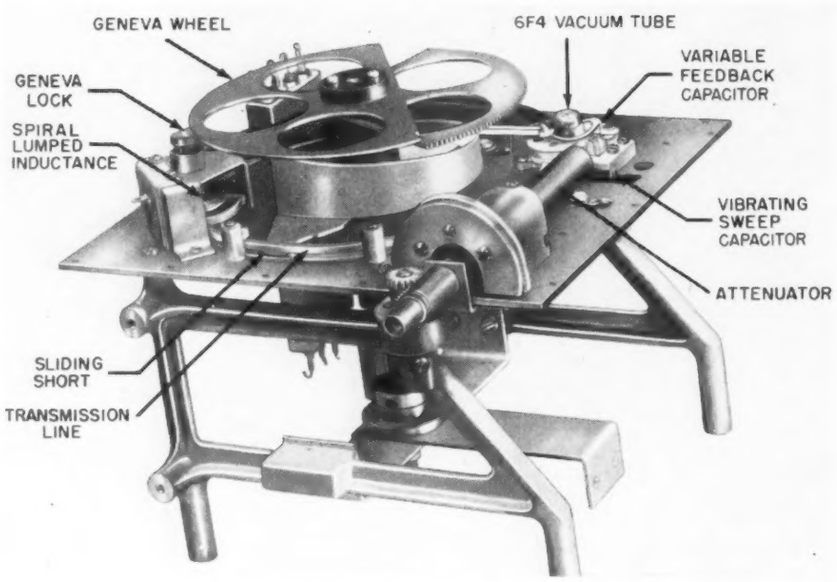


Fig. 6: Internal construction of sweep generator indicates novel tuning arrangement

sible mode of oscillation at frequencies in the UHF band and above, due to the very large grid loading which would occur at the higher modes. However, at frequencies below 200 MC, the inherent feedback capacity through the tube is insufficient to produce enough negative conductance to overcome the tube and circuit losses. Consequently, there is a strong tendency for the oscillator to jump to a higher mode of operation where there is sufficient negative conductance available to sustain oscillation.

This condition was remedied by bypassing the plate resistance of the oscillator tube with increased capacity at frequencies below 200 MC, Fig. 6 illustrates how this is accomplished. At high frequencies, the cathode-connected rotor of the variable capacitor is almost completely removed from the plate-connected stator and has negligible effect. As frequency is reduced, the rotor is gradually closer to the stator until it is separated from it by a piece of thin mica. By this technique, which effectively changes the C_{pk} of the tube from its intrinsic value of about 0.5 μμf to about 5.0 μμf, it is possible to reduce continuously the frequency to 35 MC.

Cathode Choke

In order to permit tuning of only the grid-plate circuit of the oscillator over the broad range from 35 to 900 MC, it is necessary for the total cathode-to-ground impedance to be capacitive over the entire range. Since there must be a dc return between the cathode and ground for heater and cathode current, it is necessary to design a choke that will provide the necessary dc return and yet permit capacitive reactance between cathode and ground at all oscillating frequencies.

At first approach, this broadband problem would appear to have formidable aspects, and preliminary experiments involved trials such as making high impedance lossy cable several feet in length and using a spirally wound inner conductor. The early results were not encouraging and other methods were tried.

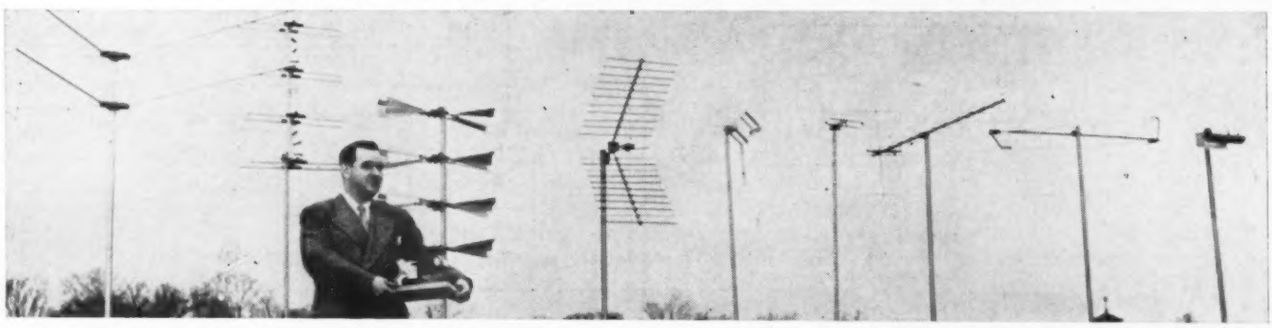
Selecting a Choke

In attempting to use typical chokes for experiments over different portions of the frequency range, it was ascertained that, in general, a choke that was suitably designed for the low frequency end of the band permitted satisfactory oscillations over the entire operating range. It was further found that despite variations in form diameter on which the choke was wound, and wire size, if chokes having self resonances anywhere from 30 to 100 MC were used, a wide variety of geometric shapes was perfectly suitable for satisfactory oscillations. Fortunately, too, this type of choke appears to be extremely uncritical as far as position in respect to neighboring ground planes, so that its use represents an extremely satisfactory solution to this part of the problem. The actual choke used is a bifilar one to provide a cathode return and filament heating path simultaneously.

By using this type of choke, it has been found possible to maintain satisfactory oscillations from 1,000 MC down to as low as 20 MC; it is quite possible that this range could be lowered to 10 MC, if one so wished, by use of a suitable choke. The limit of 35 MC as the low end of the sweep generator was set by the requirement of sufficient FM rather than by the ability of the unmodulated oscillator to go lower in frequency by the general techniques established.

(*Continued on page* 75)

ROOFTOP OF THE FUTURE SHOWING UHF TV RECEIVING ANTENNAS



Jerome E. Respess, president of La Pointe Plascomold Corp., is shown with the experimental line of VEE-D-X UHF antennas developed at his engineering laboratory in Westport, Conn., 50 air miles from the experimental UHF transmitter at Bridgeport, Conn. From left to right: the Double Vee; Colinear Array; Stacked Bowtie; Corner Reflector; Cubicle Quad; Folded Dipole; Yagi; Rhombic; and Slot

Page from an Engineer's Notebook

Number 15—Graphic Calculator for Vacuum Tubes

Easily-made device speeds computations of tube power, voltage and current relationships. Handy rule varies resistance load line

By WILLIAM MOULIC,
Chief Engineer, Moulic Specialties Co., Bloomington, Ill.

THE device illustrated in Fig. 1 is for use with the conventional characteristic family curves representing the voltage and current relationships in electronic tubes. Its purpose is to present a method whereby power output, and current and voltage relationships may be quickly determined. The value of load resistance may be conveniently varied to permit prediction of the results of such a change.

A number of common tube problems may be quickly solved through the use of this calculator, including: 1) The peak and minimum plate currents for a given grid voltage swing, supply voltage and plate load resistance; 2) The power output for a given grid voltage swing, plate supply voltage, load resistance, and operating bias; 3) The optimum value of load resistance for minimum distortion.

Construction

As shown in Fig. 1, the calculator consists of a backing sheet (bristol board or sheet plastic) upon which the characteristic curve sheet is placed. A particular calculator is not restricted to one sheet size. If it is made large enough to handle the largest curve sheet, any smaller size may also be used without change in procedure. The squaring edge is either a raised portion of the backing sheet or a separate strip fastened to the backing sheet to provide an alignment frame for the curve sheets. A transparent rule with an engraved line along its length is attached to a pivot-slide which is free to move in a slot along the lower edge of the squaring edge. This rule represents the resistance load line.

Scale A along the left vertical of the squaring edge represents the value in ohms times (times 10, 100, 1,000, etc.) load resistance. Methods for using the calculator are the same irrespective of the multiplier value for scale A. Linear scale B along the lower edge of the calculator is a reference for the position of the sliding pivot, and may be divided into approximately 0.1-inch marks.

Resistance scale A can be developed in the following manner: Select any convenient point near the upper edge of the squaring strip and let this point be 1 on the resistance scale. Also select a point on the pivot scale such that the included angle between the line through resistance value 1 and the pivot and the horizontal is 60°.

Referring to Fig. 2, let $\cot \theta = \frac{E}{I} = \frac{E}{A} = R_1 = 1$, where A is the distance from the selected point 1 to the pivot locus. Then $\cot \varphi = \frac{E}{X} = R_2$, where X is the distance from the pivot locus to a second point on the resistance scale, R_2.

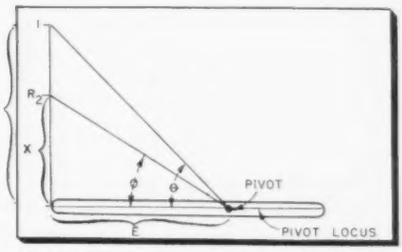


Fig. 2: Diagram for computing scale A values

Let $R_2 = \eta R_1 = \eta \cot \theta$

$\varphi = \cot^{-1} (\eta \cot \theta)$

For example, let $\theta = 60°$

$\eta = 1.05$

$\eta = 1.1$

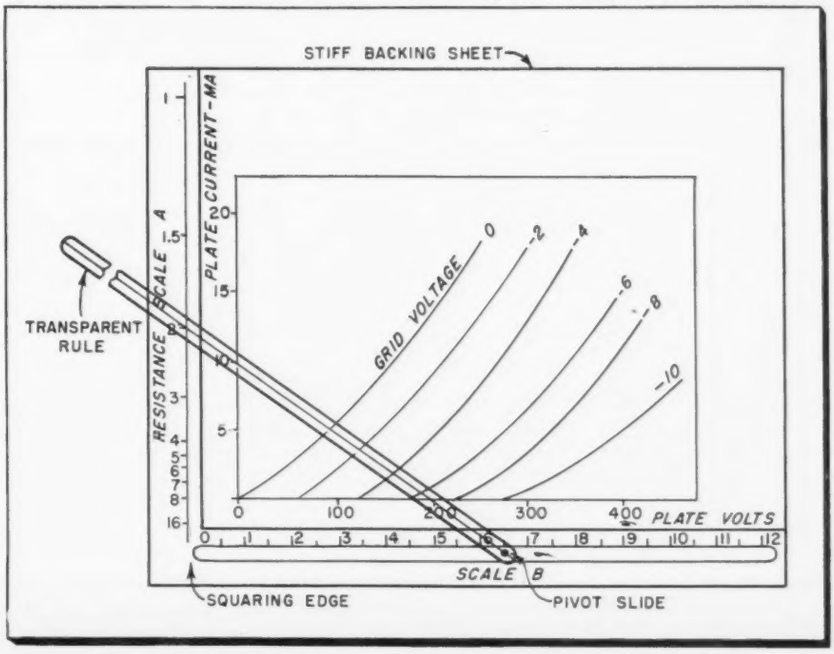
$\eta = 1.15$, etc.

then $\varphi = 58°47'$, $57°35'$, $56°25'$, etc

A calibrated scale for the calculator is shown in Fig 3. It may be copied directly, reduced or enlarged for use with calculators of different sizes.

To use the calculator, a curve sheet representing the plate voltage, plate current family is placed so that

Fig. 1: Calculator consists of backing sheet, scaled squaring edge, transparent rule and pivot-slide



CALCULATOR (Continued)

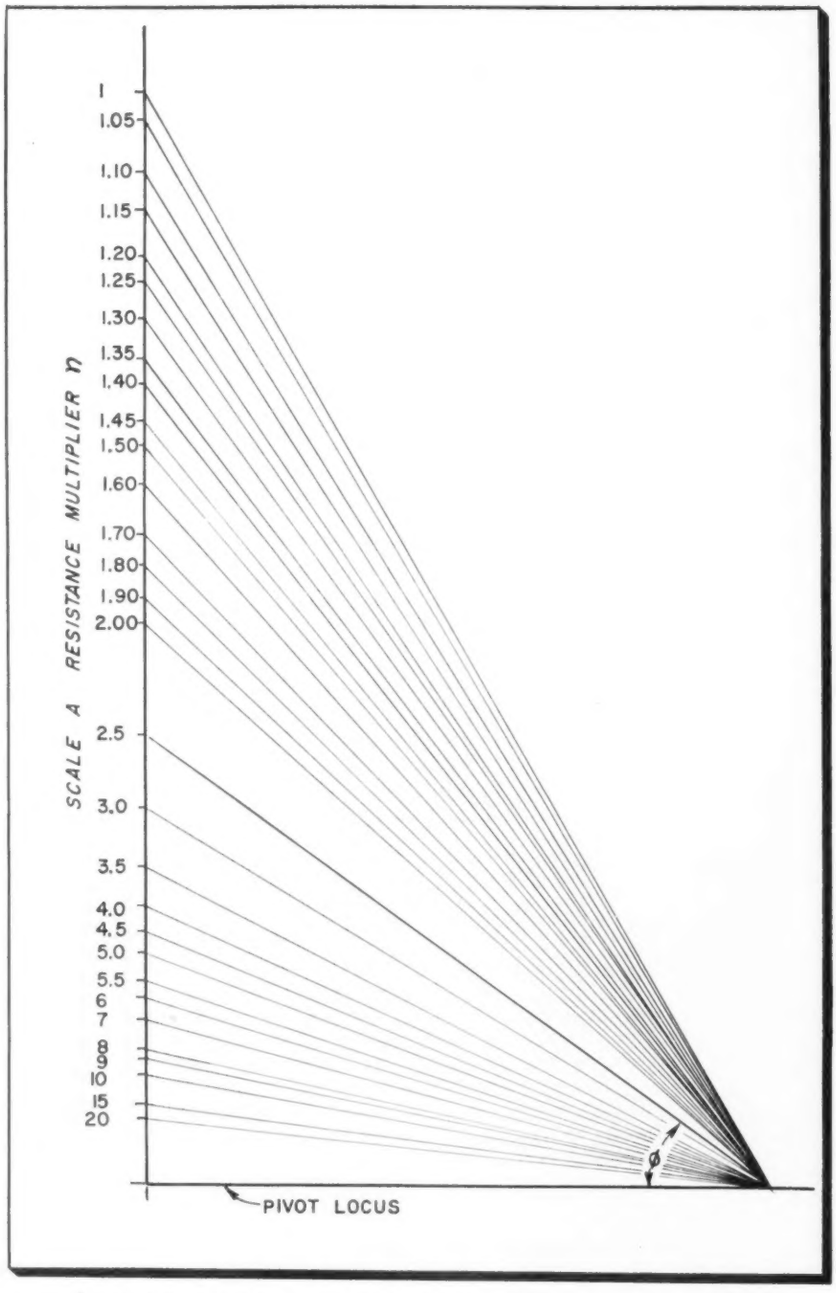


Fig. 3: Calibrated scale for calculator is shown for values of φ and η given below:

η	φ	η	φ	η	φ	η	φ
1.00	60°	1.35	52°5′	2.0	40°55′	5.5	17°27′
1.05	58°47′	1.40	51°2′	2.5	34°46′	6.0	16°7′
1.10	57°35′	1.45	50°6′	3.0	30°1′	7.0	13°54′
1.20	55°16′	1.5	49°8′	3.5	26°20′	8.0	11°29′
1.20	55°16′	1.6	47°16′	4.0	23°24′	9.0	10°53′
1.25	54°13′	1.7	45°35′	4.5	21°2′	10.0	9°49′
1.30	53°7′	1.8	43°52′	5.0	19°9′	15.0	6°35′
		1.9	42°19′			20.0	5°28′

the voltage axis is parallel with scale B, as shown in Fig. 1, The first step is to calibrate the calculator to the particular curve sheet being used. To do this, any convenient value of plate voltage is divided by a value of current, and the quotient is a resistance value.

For example, in Fig. 1, 200 v. is divided by 10 ma. to give 20,000 ohms. The rule is moved along the slot and pivoted until its engraved line passes through the values selected on the curve sheet and through the value 2 on the resistance scale. In this example, 2 on scale A represents 20,000 ohms and the entire scale is multiplied by 10,000. At this point, note the location of the pivot at 6.5 on scale B. If it is desired to change the load resistance to 40,000 ohms, it is only necessary to have the pivot at 6.5 and to move the load line rule about its pivot until it crosses the 4 on scale A.

Constant Load Resistance

As long as the load line rule maintains a fixed slope, it represents a constant load resistance for the tube. The rule may be moved along the slot to any value of supply voltage being considered for the tube and calculations performed by conventional graphical methods.

An additional improvement to the transparent rule of the calculator is a cursor made to slide along the rule and with linear graduations on either side of a center zero mark. This cursor is moved along the load line rule until the center zero marks fall on the grid bias value selected for the tube. The load line resistance value can then be adjusted until the cursor intercepts equal distances on grid voltage lines representing the peak values of the grid signal which will be superimposed on the bias.

New WWV Radio Forecasts

In addition to its established service of broadcasting radio propagation conditions, the National Bureau of Standards has instituted a forecasting service on WWV, effective July 1, 1952, which predicts communications conditions over the North Atlantic for the next 12 hours. Prepared four times daily, the short wave disturbance forecasts are transmitted in Morse code twice each hour at 19.5 and 49.5 minutes past the hour on WWV standard frequencies of 2.5, 5, 10, 15, 20 and 25 mc. As before, the letters "N," "U," and "W" are used, signifying that present conditions are normal, unsettled, or disturbed, respectively. Following this letter indication is a digit whcih describes the expected quality of transmitting conditions on the NBC-CRPL scale of 1 (impossible) to 9 (excellent). For example, a forecast statement of W7 repeated five times at 0500 UT means that at 0500 conditions are disturbed, and that average conditions are expected to improve to quality 7 (good) in the period 0600-1800.

For the past 18 months, the NBS Radio Warning Service has been making continuous 24-hour daily studies of the North Atlantic circuits by specialized techniques. The new disturbance information to be transmitted by WWV is one of the results of this investigation. Other radio disturbance forecasts which NBS has supplied regularly for almost ten years are forecasts of propagation conditions 1 to 25 days in advance and daily 24-hour forecasts. Neither of these services are broadcast by WWV but are distributed by airmail, telephone, and telegraph. Similar forecasting services are provided for North Pacific circuits by NBS at Anchorage, Alaska.

Eidophor Projector for Theatre TV

New system employs unique light valve principle to produce large-screen pictures approaching the quality of motion pictures

A new system for large screen color TV projection—Eidophor—has recently been introduced in the U. S. by Twentieth Century-Fox Film Corp. Essentially of the same size and shape as conventional motion picture projectors, the device provides ample illumination to satisfy the needs of even the largest theatres. See Fig. 1.

Credit for the discovery of the novel principle used in the system belongs to Dr. Fritz Fischer of Switzerland's Federal Institute of Technology, who died suddenly in 1947. The development of the basic black-and-white system, initiated 12 years ago, has been carried out by Dr. Hugo Thiemann of the Swiss Institute and Dr. Edgar Gretener A. G. of Zurich.

Twentieth Century-Fox, which holds the world-wide rights for the manufacture and distribution of the projectors, has adapted Eidophor for color through its joint efforts with CBS. Engineering development by Twentieth Century-Fox has been under the direction of Earl I. Sponable, co-inventor of the sound-on-film process currently used throughout the motion picture industry.

Operating Technique

Operation of the Eidophor system is illustrated in Fig. 2. Light from the arc lamp (1) passes through the aperture plate (2), color wheel (3), condenser lens (4) and strikes the mirror bar system (5). This plane mirror is tilted at 45° to the direction of this initial light beam, and has open slits between and about as wide as the parallel mirror bars. Consequently, half of the light passes through (5) and is lost, while the other half is reflected down on the spherical mirror (7). Assuming for the moment that the thin oil surface, or Eidophor liquid, covering (7) is not disturbed, the incident light on area (8) will be reflected back to the parallel mirror bars of (5) and on to (1) along the same path as the original incident beam. On the other hand, if the liquid surface is deformed by an electron beam from gun (6), the light impinging on (7) will be deflected so that the reflected beam does not strike the mirror bars of (5) but rather passes through the slits and then through the projected lens (10), to the directing mirror (11), onto the theatre screen (12).

Definition is determined by the number of mirror bars, which project parallel lines of light on area

(*Continued on page* 112)

HOW GOOD IS EIDOPHOR PICTURE QUALITY?

A recent demonstration using a 525-line raster, 8 MC bandwidth and field-sequential color projected on a 15 x 11.5 ft. screen, gave the editors of TELE-TECH the following impressions:

- **Overall quality was splendid and approached that of best motion picture projection.**
- **Brightness was about equal to motion pictures.**
- **Definition was excellent.**
- **Color fidelity was very good, with only slight color "hangover" which would not normally be noticed by lay observers.**
- **Contrast ratio of 1:200 was quite adequate.**

Fig. 1: Eidophor system comprises: (1) Projector; (2) Projection light beam hood; (3) Color wheel; (4) Auxiliary services, vacuum pump and cooling system; (5) Projection lamp; (6) TV receiver circuits

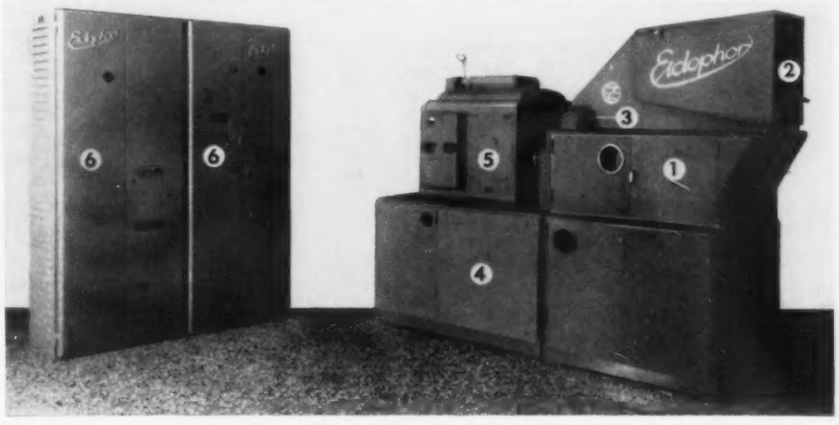
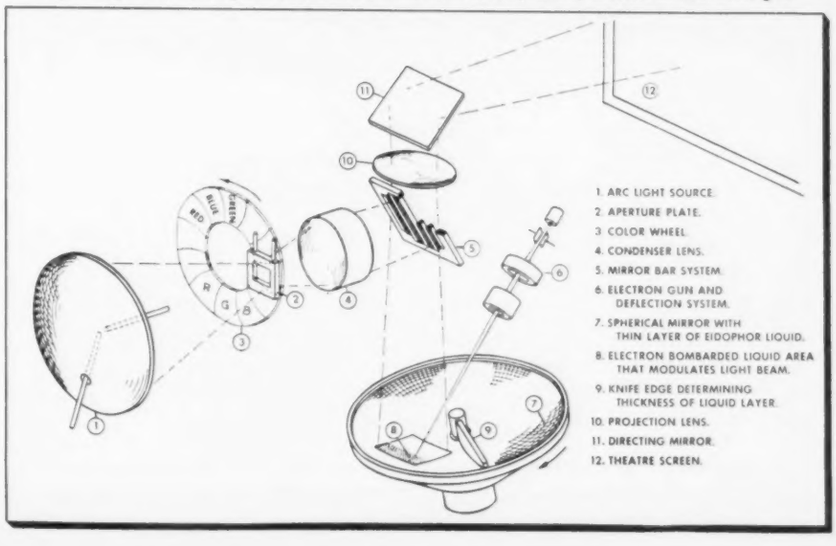


Fig. 2: Operational diagram shows arc source, color wheel, lenses, mirrors and electron gun


1. ARC LIGHT SOURCE.
2. APERTURE PLATE.
3. COLOR WHEEL.
4. CONDENSER LENS.
5. MIRROR BAR SYSTEM.
6. ELECTRON GUN AND DEFLECTION SYSTEM.
7. SPHERICAL MIRROR WITH THIN LAYER OF EIDOPHOR LIQUID.
8. ELECTRON BOMBARDED LIQUID AREA THAT MODULATES LIGHT BEAM.
9. KNIFE EDGE DETERMINING THICKNESS OF LIQUID LAYER.
10. PROJECTION LENS.
11. DIRECTING MIRROR.
12. THEATRE SCREEN.

Microphone Directivity and

Applications for omnidirectional, semidirectional
Importance of Distance and Directivity Factor

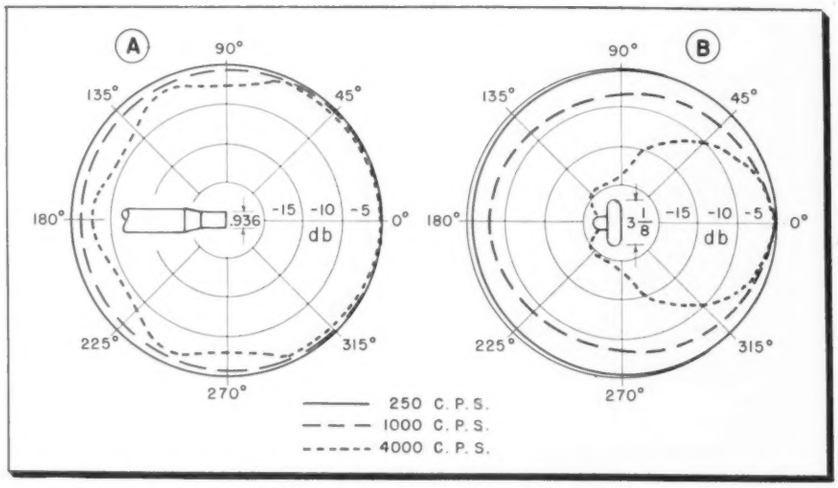


Fig. 1: Polar patterns of (a) omnidirectional and (b)semidirectional microphones for three frequencies

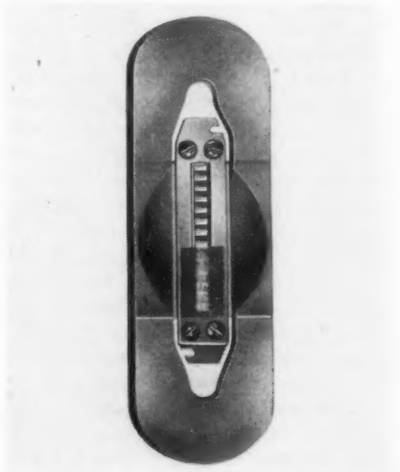


Fig. 2: Recent small gradient type element

By B. B. BAUER
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BRIDGING the auditory gap between binaural human hearing and the monaural characteristics of conventional pressure microphones is the directional microphone, which serves partially to overcome the limited sound localizing capabilities of monaural systems by concentrating on desired sounds. This article reviews microphone directivity and the utilization of directional microphones in the light of recent developments.

The choice of a microphone by the purchaser depends upon several factors—technical, financial, and aesthetic; an important consideration is the mode of the moment. At this writing, the "new look" in microphone fashions is the elongated miniature type. Unfortunately, as is often the way with fashions, the choice of the mode of the moment does not necessarily indicate compliance with sound physical principles. It is well to remember that while miniaturization per se is not bad, it is not good—unless directional properties are kept in the foreground.

To review the directional performance of pressure microphones, Fig. 1a shows the polar patterns of the A.S.A. Standard Type L microphone and preamplifier. It is the forerunner of all present-day omnidirectional "miniature" microphones. Only one surface of the diaphragm is exposed to sounds, and, therefore, the directional properties are dependent solely upon the ability of sound pressure to reach the diaphragm front. The diameter of the microphone is only 0.936 in., and sound pressure from all directions can reach it very well indeed. As a result of this small diameter, this microphone is quite non-directional, or "omnidirectional." The directivity patterns at 250 and 1000 CPS do not deviate from a perfect circle by more than 0.5 db. At 4000 CPS, the response begins to drop from the side and the rear; nevertheless, it is still within 3 db of being uniform. Although omnidirectional pickup retains reverberant qualities and is useful for sound level measurements, it does not provide sufficient control over undesired sounds; this accounts for the continued popularity of the earlier type semidirectional microphones in many broadcasting and communications applications.

The polar patterns of a typical semidirectional microphone are shown in Fig. 1b. Sounds with frequency of 250 CPS and below are received by the microphone with almost complete uniformity. However, beginning with 1000 CPS and above there is considerable directivity caused solely by the diffractions of sound around the microphone case when the wavelength is comparable to, or smaller than, the dimensions of the case. Therefore, directivity increases with frequency. Semidirectional microphones are useful in separating high frequency noises, such as applause and footsteps from the voice of the commentator.

Improving Directivity

To improve directivity at low frequencies without a corresponding increase in size, the velocity microphone was developed in 1932. Velocity microphones owe their directivity to the "gradient" of sound pressure, that is, to the space-rate change of sound pressure in the direction of propagation. The front-and-back directivity may be plotted as a figure-8 polar pattern. The construction consists of two elongated pole pieces and a thin aluminum ribbon which floats back and

Miniaturization Effects

nd directional microphones outlined.

n using different types is analyzed

rth in the magnetic field as a result of sound pressures at its sides.

Despite the many valuable characteristics of gradient microphones, often a unidirectional microphone is desired. In the phase shift microphone, the sound travels an additional distance before reaching the rear entrance ports. Therefore, the pressure at these ports is delayed, causing a phase shift. To this point, the operation is identical with that of the gradient microphone. However, a new element is now introduced, in the form of an acoustical phase shift network designed to shift the phase of sound entering the port. One should keep in mind that the external phase shift varies directly with the frequency. Therefore, the internal phase shift must also increase with frequency to maintain the directional pattern at all frequencies. To fulfill this condition, the phase shift network is designed to provide an internal phase shift which is proportional to frequency throughout the important working range of the instrument.

Small Directional Microphones

In Fig. 2 is shown a new small gradient type element introduced in May 1952. The magnetic structure consists of a soldered assembly of two Alnico magnets, two soft iron pole pieces, and a ribbon mounting frame. The assembly is 2½ in. long, ⅞ in. wide, and ½ in. deep. The ribbon element is approximately 1 in. long, 1/16 in. wide, and 0.0001 in. thick, and it is suspended in the air gap so that it is free to move to-and-fro with a clearance of approximately 0.003 in. at either side. The ribbon is suitably insulated from the frame, and the electrical connections are made to the terminals at either end. To protect the ribbon from dust, a fine mesh screen is installed at both sides before magnetizing. Access to both sides of the ribbon is achieved through perforated metal grilles. The lower part of the case enclosing the gradient element contains the low impedance-to-line transformer, and a switch for selecting either the low, medium, or high impedance winding. The case is mounted on a cable connector shell through a rubber bushing. The shell contains a frequency modifying choke and a voice-music switch.

A relatively small unidirectional phase shift microphone cartridge introduced in March 1951 is shown in Fig. 3. The front of the diaphragm is freely exposed to sound. After traveling around the pole piece, the pressure enters through the slit formed by the voice coil and the bobbin, which is part of the phase shift network, into the chamber at the rear of the diaphragm, and thereupon it is bypassed through the acoustical screens into the inner volume of the magnet and into the rear chamber. An appropriate choice of acoustical constants of the slits, screens and volumes produces a phase shift proportional to frequency throughout the useful frequency range of the network. The polar pattern is a cardioid at all important frequencies.

Physical Characteristics

The unidirectional unit is approximately 1⅝ in. square and 2¼ in. long. It is mounted in a case using elastic rubber mounts. The multi-impedance voice coil-to-line transformer is located below the unit and the switch is conveniently accessible at the rear base portion. The profile of the 3-in. deep case as seen by the audience is approximately 2 in. wide.

The ability of a directional microphone to favor reception of frontal sounds is described by a number called the Directivity Factor. This term is defined as the ratio between the power transmitted by the microphone owing to frontal sound and the power transmitted owing to random sounds of equal intensity. To determine the Directivity Factor, let the sounds from the performer impinge directly upon the front of the microphone and note the power output. Next, remove the direct sound and let the noises and other undesired sounds, as from excessive

(*Continued on page* 110)

Fig. 3: Unidirectional phase shift cartridge has a cardioid polar pattern at all important frequencies

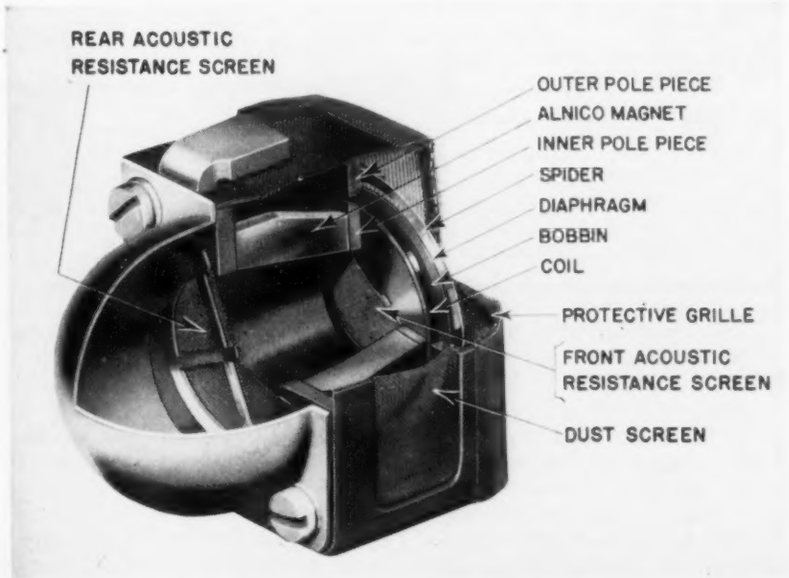
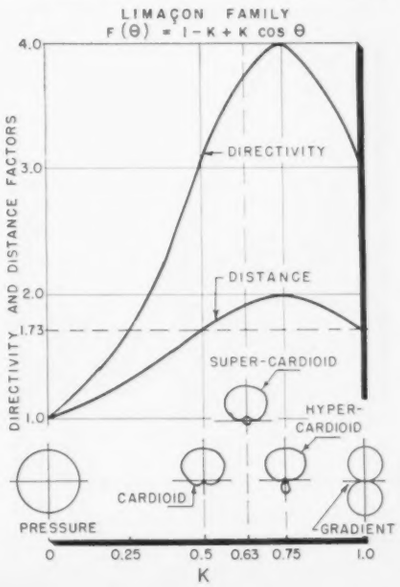


Fig. 4: Directivity and Distance Factors for microphone polar patterns of Limacon family



Measurement of Amplitude Linearity

Overall system performance may be accurately determined by proper measurement characteristic. Terminology such as gamma, gradient and gain are clarified. Picture

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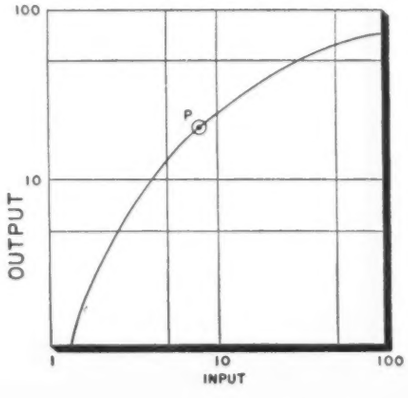
AMPLITUDE linearity is one of many factors which determines the performance of a picture transmission system. It is also a factor which has received a disproportionately small amount of engineering attention in view of its effect on the quality of the TV picture. The purpose of this paper is to outline the methods of expressing the amplitude characteristic of all or parts of the TV system. It is felt that complete consideration of system performance including noise characteristics is beyond the scope of this paper. The very thorough paper of Oliver[1] treats the situation in detail. Therefore the material presented here is fundamental and aims only at clarifying an often and easily misunderstood subject.

Fundamentally, then, what must a TV system do? It certainly is unnecessary and often undesirable, exactly to reproduce the original scene. The output from the display device may not be like the original scene when expressed in physical terms, but when the eye is considered as an integral part of the reproducer, the illusion of viewing the original scene may be accomplished. This philosophy is implicit in all our present standards and becomes even more obvious when we begin to add chromaticity information to our system.

Fig. 1: Transfer characteristic results in different values of gamma for various inputs



It seems that the term amplitude linearity is somewhat of a misnomer because we do not necessarily want a reproduced brightness which is directly proportional to that of the original scene. The desired transfer characteristic may involve a large number of variables including the limitations of the equipment as well as physiological, psychological, and aesthetic factors. Since we, as engineers, are not satisfied with such a vague and variable situation, we can summarize our requirements in more rigorous form. The transfer characteristic of the system should be known and controllable. Consequently, it is necessary to measure and express the amplitude transfer characteristic so that, regardless of what its form may be, the overall performance of the system can be accurately determined.

Measurement Difficulties

The difficulty in accomplishing these two requirements of measurement and expression is implicit in our mathematics; that is, with the mathematical tools at our disposal at the present time, the solution of equations representing non-linear

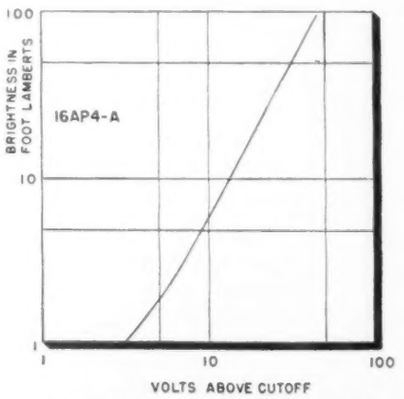


Fig. 2: Transfer characteristic of 16AP4-A has constant slope, giving one value for gamma

elements is, at the least, ponderous and unrewarding, and often impossible. The classical approach to nonlinear devices usually involves representation by a power series with as many terms as needed for the desired accuracy. When we are fortunate, it is sometimes possible to represent the device by a single exponential; it has been pointed out, notably by Oliver, that the picture tube characteristic can be approximated and manipulated in this way. Regardless of the technique used, interpretation of the statements poses somewhat of a problem, and not a small part of the problem is that of terminology.

Gamma

The most commonly used, and most frequently misinterpreted term is gamma. If some portion of the amplitude transfer characteristic can

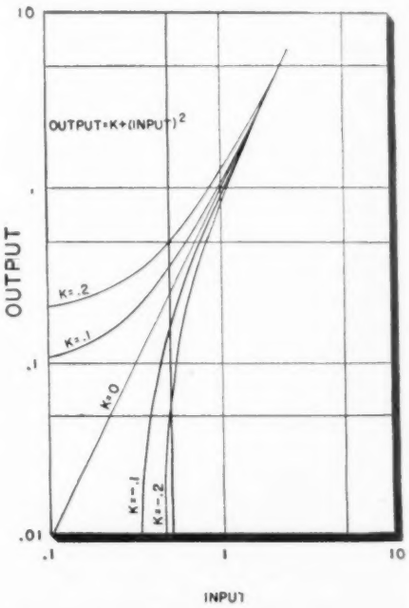


Fig. 3: Variations of transfer characteristics produced by small changes in the value of K

be approximated by a single exponential we can state that over the region of approximation:

$$\text{Output} = K\ (\text{Input})^{\gamma} \qquad (1)$$

and the exponent is gamma. It is sometimes written as follows, after taking the logarithm of both sides:

$$\gamma = \frac{\text{Log (Output)} - \text{Log } K}{\text{Log (Input)}} \qquad (2)$$

Of course, for any single value of gamma this expression will become

in Television Receivers

and expression of the amplitude transfer

tube brightness and tone rendition examined

a straight line when output versus input is plotted on log-log paper, and the slope will be gamma.

If the transfer characteristic we are considering followed this law through all values of input, this

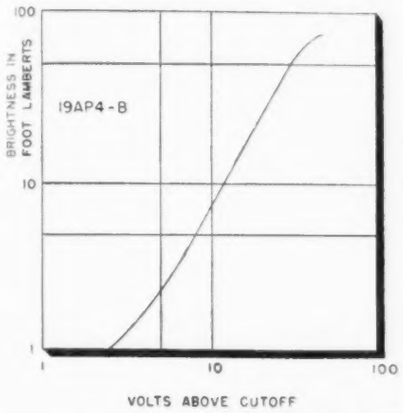


Fig. 4: Amplitude transfer characteristic of 19AP4-A picture tube has wide range of slopes

would be a simple and useful expression. However, suppose we have a device which has the transfer characteristic shown in Fig. 1 as plotted on log-log paper.

Gamma is just eq. (2) evaluated for some point on the curve. It should be noticed that this curve is not a straight line on the log-log plot. As we consider points on the curve, we obtain different values of gamma. The statement of a gamma in this case is meaningless unless we say at what point it applies. Even then its usefulness is small unless some procedure such as has been used in photography is employed. Then the gamma that is stated is the maximum gamma of the curve. Since there are an infinite number of curves which can have the same maximum gamma, the value of such an expression is debatable. However, if we consider a transfer characteristic of a typical picture tube the situation is somewhat better, as can be seen from Fig. 2.

In this case, the slope of the curve is constant over a wide range of input values. Therefore, over this range, a single value of gamma may apply. For this curve, gamma has meaning; that is, the device follows

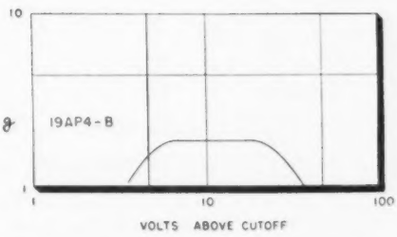


Fig. 5: Plot of 19AP4-A gradient indicates considerable compression of blacks and highlights

a 2 power law, or has a gamma of 2 from about 8 v. to 40 v. of input. Outside of this range the term gamma cannot be meaningfully applied.

Gradient

Oliver has defined another term, gradient, which is described as "the slope of the overall brightness characteristic when plotted on log paper." This differs from gamma in that it is defined as the ratio of the derivatives of the log output to the log input.

$$g = \frac{d\ (\text{Log Output})}{d\ (\text{Log Input})} \qquad (3)$$

By plotting g as a function of input, curves of considerable usefulness can be obtained particularly with systems which cannot be represented by a single exponential. Actually, a non-linear device following a simple exponential law should be represented by a more general expression than eq. (1), as shown below.

$$\text{Output} = K_1 + K_2\ (\text{Input})^n \qquad (4)$$

K_1 in the case of a picture tube could be the background or bias setting. How the log-log plot of a typical device varies with K_1 is shown in Fig. 3. In this case, $n = 2$ and $K_2 = 1$. It can be seen that positive values of K_1 produce curvature which tends to decrease the slope, or gradient, in the region of curvature, and that negative values of K_1 produce curvature of an increasing gradient.

It can also be seen from Fig. 3 that very little change in K_1 is required to produce a large change in curvature at low levels. One effect of this high sensitivity to K_1 is to make the

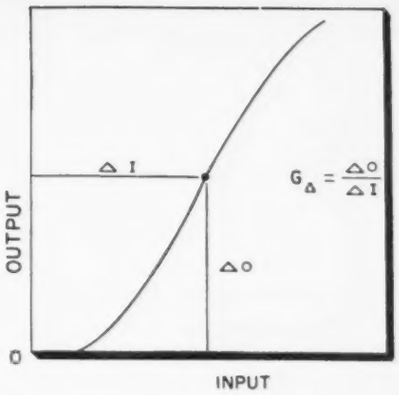


Fig. 6: Ratio of delta output to input of transfer characteristic gives incremental gain

so called brightness control in TV receivers a contrast control.

In these curves gamma means practically nothing. Sometimes gamma is used with the meaning that it is the slope of the curve over its straightest portions. As little rigor is attached to such a definition, it would appear that the use of gradient would provide the same information and at the same time be quite rigorous. A simple example of the application of the expression, gradient, can be obtained by plotting the amplitude transfer characteristic of a picture tube. A 19AP4-A is shown in Fig. 4. For this plot, a background bias of about 10 v. above cutoff was used. It should be noticed that this curve approaches a straight line on log-log paper over a fairly short range of input values. This can be seen quite clearly from a plot of the gradient of this tube, as shown by Fig. 5.

Gradient and Compression

As the gradient is small (approaching unity) at low levels, and quite large (approximately two) at high levels, the reproduced picture will suffer from considerable compression of the blacks. As the gradient of this tube falls off at very high brightness levels, there is also some compression of highlights compared to the lighter shades of grey. If the tube were perfectly linear, it would have a gradient which would be a constant of unity.

Gradient is most useful when describing overall system amplitude transfer. As the derivative of log output divided by the derivative of log input is just the ratio of the percentage change in output to the percentage change in input, gradient expresses the situation much as it is *seen* by an observer. A plot of overall gradient versus original scene

(*Continued on page* 90)

High-Sensitivity Gas Tube Detector

Rugged gaseous discharge tube equals or surpasses performance of crystal mixers. Accurate positioning in waveguide measurements assured

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GERMANIUM and silicon crystals used for detecting and mixing microwave signals are essentially voltage operated devices. Their location at points of maximum electric field intensity is important, and the polarization pattern or mode of the electromagnetic field must be carefully considered in determining the optimum location.

When dealing with very short wavelengths, three cm or less, the location problem may be solved by using a waveguide of relatively small cross-section, so that transmission will be restricted to the dominant mode. The crystal may, by this means, easily and properly locate at the midpoint of the long dimension of the cross-section. The procedure is subject to objection, however, as the dimensions may become so small as to result in excessive attenuation, and the power handling capacity of the waveguide is limited by the hazard of voltage breakdown of the gas filling the guide.

Increasing waveguide dimensions removes the latter two impediments, but the larger dimensions may permit higher order modes. This introduces the difficulty that a crystal properly located for one mode does not necessarily represent an acceptable location for higher order modes.

An elegant solution to the dilemma would be the provision of a detecting medium responsive to the energy of the microwave, but the microwave photon energy, at a wavelength of three cm is of the order of 2×10^{-7} that required for the photocell responsive to the longest known wavelength, and no other available media responsive to the energy are known. The location problem, among others, was surmounted by use of an ionized gas tube.

The experimental equipment consisted of a reflex klystron oscillator operating at 9,375 MC together with a power supply and square wave modulator, a crystal monitor to ensure constant r-f power input to the gas tube detector, calibrated and uncalibrated attenuators, standing wave detector, matching stub, plunger tuner, calibrated amplifiers for reading sensitivity levels, and the gas tube connected to a vacuum manifold. Fig. 1 shows the equipment setup employed in the experimental waveguide system.

Power Supply

A regulated power supply was connected to the electrodes of the tube for excitation. In parallel therewith, protected by a blocking condenser, was a calibrated amplifier to measure the output of the gas tube. A diagram of the dc system, with connections to the amplifier, is presented in Fig. 2.

The first type of tube used was made from 8 mm pyrex tubing containing two parallel, nonconcentric nickel cylinders 1.27 mm in diameter and separated 2.47 mm, center-to-center at the free ends of the electrodes. (This is hereinafter referred to as the "cylindrical tube" and is shown in Fig. 3.) Corresponding separations of closest surfaces were 1.22 mm at the free ends. Electrodes were approximately 28.6 mm long, sufficient to pass through the entire long cross-section dimension of the waveguide. The cylindrical tube proved to be the most sensitive of any of the geometries employed.

Rectangular Tube

The next type of tube (hereinafter referred to as the "rectangular tube") contained electrodes made of flat rectangular nickel plates, separated approximately 1.27 mm, and of dimensions 15.9 mm wide and 25.4 mm long. The glass envelope was a rectangular parallelepiped, blown to fit snugly into, and completely fill the interior of the waveguide of interior cross-section 9.53 mm x 22.2 mm.

Another type used (hereinafter referred to as the "test bulb") was a commercial neon test bulb. The electrodes of this commercial tube were also of nickel and of similar separation and size as the "cylindrical tube," but only 7.95 mm long. The electrodes were activated over the surface with oxides of barium

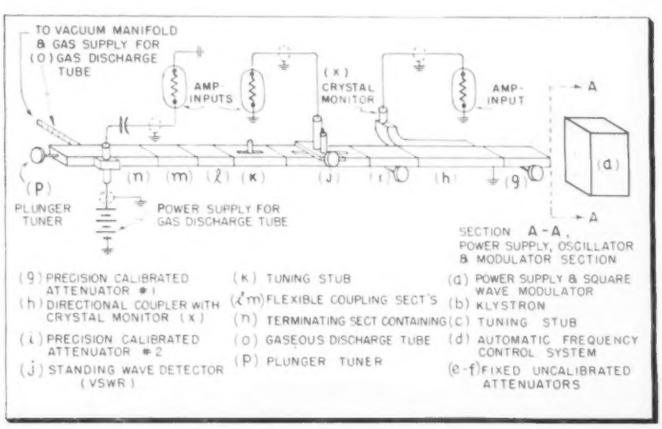
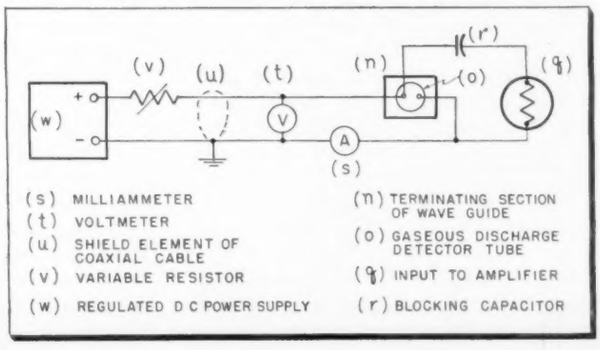

TO VACUUM MANIFOLD & GAS SUPPLY FOR (o) GAS DISCHARGE TUBE
AMP. INPUTS
(x) CRYSTAL MONITOR
AMP. INPUT
(p) PLUNGER TUNER
POWER SUPPLY FOR GAS DISCHARGE TUBE
SECTION A-A, POWER SUPPLY, OSCILLATOR & MODULATOR SECTION
(g) PRECISION CALIBRATED ATTENUATOR #1
(h) DIRECTIONAL COUPLER WITH CRYSTAL MONITOR (x)
(i) PRECISION CALIBRATED ATTENUATOR #2
(j) STANDING WAVE DETECTOR (VSWR)
(k) TUNING STUB
(l'm) FLEXIBLE COUPLING SECT'S
(n) TERMINATING SECT CONTAINING
(o) GASEOUS DISCHARGE TUBE
(p) PLUNGER TUNER
(a) POWER SUPPLY & SQUARE WAVE MODULATOR
(b) KLYSTRON
(c) TUNING STUB
(d) AUTOMATIC FREQUENCY CONTROL SYSTEM
(e-f) FIXED UNCALIBRATED ATTENUATORS

Fig. 1: (1) Equipment setup in experimental waveguide system

Fig. 2: (r) Direct current system with amplifier connections



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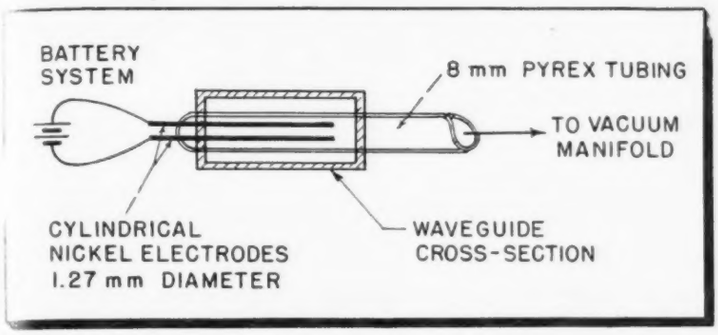

Fig. 3: Gas tube of cylindrical construction contains nickel electrodes separated 2.47 mm

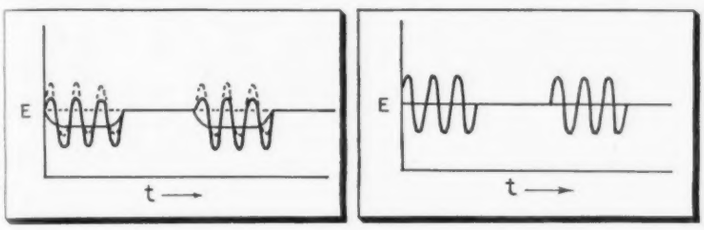

Fig. 4: (1) Non-symmetrical wave and detected audio intensity in presence of electron stream. Dotted lines show reference symmetrical wave in absence of electron stream. Fig. 5: (r) Symmetrical intensities in absence of an electron stream results in no detection

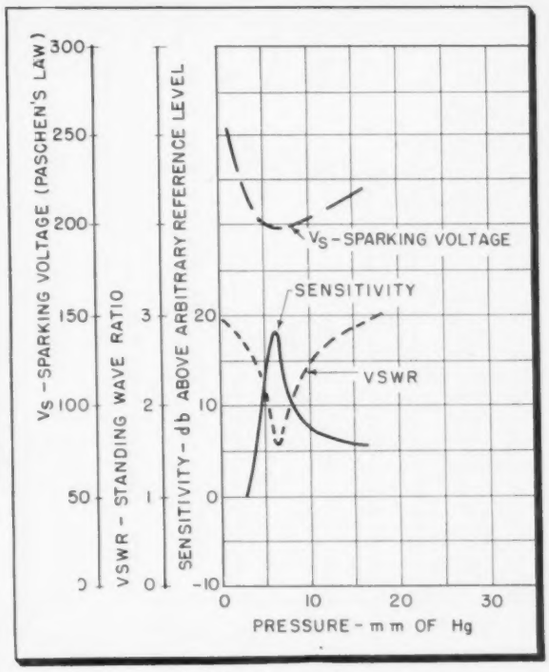
VS - SPARKING VOLTAGE (PASCHEN'S LAW)
VSWR - STANDING WAVE RATIO
SENSITIVITY - db ABOVE ARBITRARY REFERENCE LEVEL
VS - SPARKING VOLTAGE
SENSITIVITY
VSWR
PRESSURE - m m OF Hg

Fig. 6: Characteristics of argon at different pressures

and strontium. The gas pressure was 40 mm of mercury and the neon gas was mixed with a fraction of one percent of argon.

Preliminary experiments with the cylindrical tube disclosed that: (a) detection was only possible when the tube was excited into glow region, but not possible in the arc condition because of noise. The intensity of the detected signal varied somewhat linearly with current density, (b) Being assured that only the TE_{01} mode was present in the guide, the discharge tube was inserted endwise in the tube and moved slowly across from one vertical side of the guide to the other. The intensity of the detected signal varied roughly in a sine wave pattern, being greatest at the midpoint, the location of the greatest magnitude of electric intensity in this mode.

The intensity of the detected signal varied directly with the manipulation of field attenuators. Of the various mounting positions convenient, the greatest sensitivity resulted when the plane of the electrodes was in the greatest degree parallel to the direction of the microwave electric field intensity, and covered the portion of the waveguide cross-section in which the electric field intensity was greatest.

From observations (a) and (b) above, two preliminary conclusions may be drawn leading to an explanation of the detecting action: (1) the greatest sensitivity occurs at gas tube conditions giving the greatest supply of electrons, and (2) detection is the result of the action of the microwave electric field intensity on these electrons.

Detection Effect

On the half of the microwave cycle in which the direction of the electric field intensity vector is from anode to cathode, the microwave field imparts positive acceleration to the electron, increasing its velocity in the direction of the anode. A transfer of energy from the microwave electric field to the moving electron is effected, and the intensity of the microwave field is decreased. By the same reasoning, on intervening halves of the cycle electron velocity is decreased, with a resultant energy transfer from the electron to the microwave electric field.

Fig. 4 shows the effect of the presence of an electron stream in conjunction with the microwave field being pulsed. The magnitudes of the microwave electric intensities on the positive halves of the microwave cycles are decreased since the microwave field is imparting energy to the electrons. On the remaining halves of the cycles, the situation is reversed, and the microwave electric field intensities are increased.

The presence of the microwave field therefore results in a net average current decrease, shown by the dotted line parallel to the magnitude of the dc field in Fig. 4. When this is combined with the magnitude during periods when the microwave field is off, a net ac component at the audio pulse rate is observed.

Fig. 5 shows the time variation of the electric field intensity of the microwave and dc fields in the absence of an electron stream. It will be noticed that there is no variation in the average of the electric intensities, whether or not the pulsed microwave field is present, and no detection results.

The resultant asymmetrical microwave electric field intensity (Fig. 4) influences the external circuit in a manner similar to the action of the electron beam in a klystron. The microwave portion of the field accelerates the electron positively or negatively. The time rate of change of the electric field due to the electron in flight induces a current in the external circuit. This microwave portion of the total current is averaged, owing to the resistance and distributed capacity of the external circuit, resulting in a net decrease of total discharge current as shown in Fig. 4.

Having determined above that detection sensitivity is greatest when

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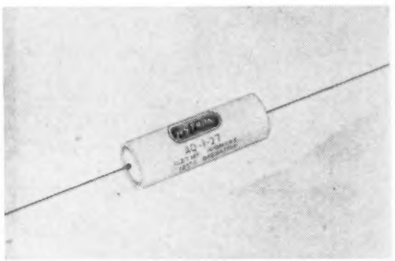
New Equipment and Components

Capacitors

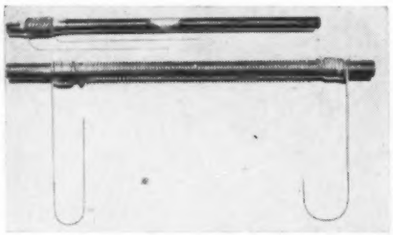
Incorporating the use of newly-developed X-250 high-temperature impregnant, type AQ capacitors offer capacitance stability over a



wide temperature range (from −65°C. to +125°C.), without derating, plus high insulation resistance, low power factor and high test voltage. These capacitors are supplied in the extended foil, non-inductive type construction. They are capable of meeting all military requirements, and are especially recommended for use under adverse operating conditions. Hermetic sealing is provided by use of glass-to-metal seal terminals. They are available in a variety of hermetically sealed metal tubular cases and construction styles.—**Astron Corp., 255 Grant Ave., E. Newark, N. J.**—TELE-TECH.

Ferrite Rod Antennas

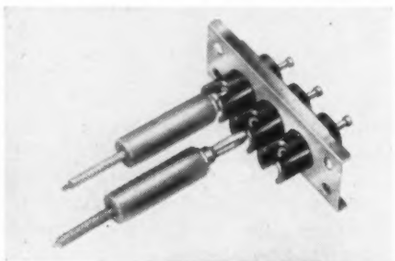
A new line of ferrite rod antennas includes ¼ in. diameter x 8 in. long, 5/16 in. diameter x 8 in. long, ⅜ in. diameter by 5 in. long,



⅝ in. diameter x 7 in. long and other required sizes. Inductances are held to ±½ of 1% and matched to the set for which they are intended. The antennas come without mountings or with mountings to the specifications desired.—**Heppner Manufacturing Co., Round Lake, Ill.**—TELE-TECH.

Terminal Block

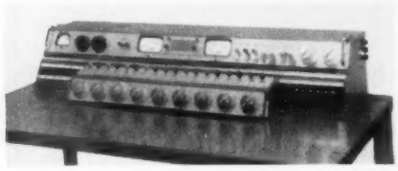
A new terminal block, known as the Curtis "FTB," is a feed-thru type with solder or screw connections on one side and provisions



to receive banana plugs on the other. This new unit is factory assembled in any number of terminals from 1 to 16. Each terminal is individually insulated and held permanently in a metal strip. The "FTB" is conservatively rated at 300 v. between terminals of opposite polarity and to ground, 20 amps.—**Curtis Development and Manufacturing Co., 3266 N. 33rd Street, Milwaukee 16, Wis.**—TELE-TECH.

Broadcast Console

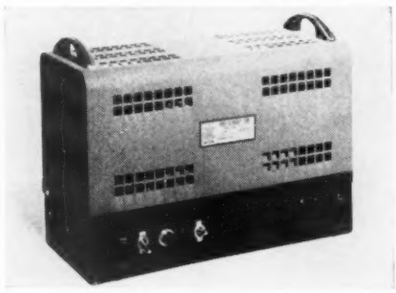
The 250A Console is a completely self-contained ac operated unit designed for high quality control in AM, FM or TV broadcasting. The preamplifiers are only 1⅝ in. wide, 4¼ in. high and 9 in. long, and the line amplifiers and power supplies are only 2⅜ in. wide. The standard console contains five A-428A preamplifiers for microphone preamplification, and two A-428A preampliers for boosters. There are also two A-429A line amplifiers, one A-429A monitor amplifier, two P-522A power supplies and one P-523A power supply. Provisions are made for two additional preamplifiers for increased microphone facilities. Nine mixing controls with a total possibility of 18 inputs through switching keys and patching panels make up the basic input circuit. Available input impedances are 30/150/250, or 600 ohms with a nominal output impedance of 600± ohms. The fre-



quency response is ±1 db from 20-20,000 cps and the signal-to-noise ratio is 70 db.—**Distributed by Graybar Electric Co., Inc., Altec-Lansing Corp. 9356 Santa Monica Blvd., Beverly Hills, Calif.**—TELE-TECH.

AC Regulator

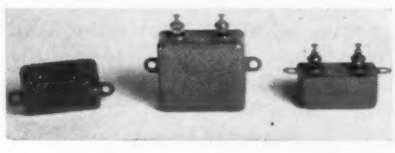
A precision ac line voltage regulator suitable for regulating voltage to analog computing set-ups, servo systems, etc. will regulate



line voltage to 0.01% and has a transient time constant of less than 0.01 sec. It may be used on either 60 or 400 CPS lines. This unit which is known as the model 116, has a power handling capacity of 100 v. amps. The transient time constant of less than 0.01 sec. meets present needs for more rapid response to load changes. Input voltage is rated at 115 v. ±10%, 400 CPS ±10% or 60 CPS ±10%. Output voltage is 115 v. (adjustable over at least a ±10% range). Developed harmonics are less than 1%. Transient time constant is less than 0.01 sec.—**Avion Instrument Corp., 299 State Highway #17, Paramus, N. J.**—TELE-TECH.

Capacitor

The Stablelex "D" capacitor is said to hold its charge for as much as 200 days or longer. Components with characteristics like the Stablex D should be extremely useful in any computing devices which are required to store information for an extended period of time. Change in capacity from +20°C to −80°C is +0.8%. Power Factor at 20°C.



measured at 1 KC is 0.00025. Insulation resistance at 20°C is 900,000 and "Q" at 20°C, measured at 10 KC is 10,000. Self time constant of the 10 μf capacitor is 4800 hours. Dielectric absorption is 0.025%.—**Industrial Condenser Corp., 3243 North California Ave., Chicago 18, Ill.**—TELE-TECH.

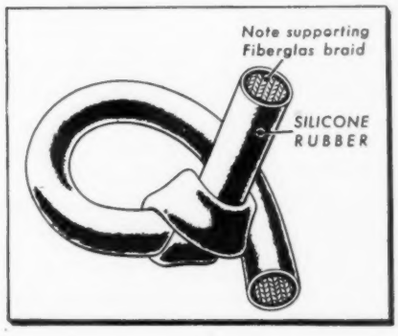
Five-Inch Oscillograph

Model 670 five-in. oscillograph for AM and TV receiver alignment contains dc amplifiers to provide excellent square wave response on both high and low frequencies. Deflection sensitivity in mv/in. is: vertical

amplifier, 10; vertical direct, 12,000; horizontal amplifier, 70; and horizontal direct, 13,000. Frequency range of the vertical amplifier is dc to 500 KC, down 3 db. It is useable to 2 MC. Horizontal range is 0 to 250 KC. Sweep oscillator covers 3 to 50 KC, and fixed sweep frequencies are 30 and 7875 CPS. Power consumption is 65 watts at 115 v. ac. The 28-lb. unit is 9.25 x 12.25 x18 in.—**Hickok Electrical Instrument Co., 10523 Dupont Ave., Cleveland 8, Ohio.**—TELE-TECH.

Insulation

A new electrical insulation made of braided fiberglas with a coating of silicone rubber, known as BH "1151," is a class H insulation

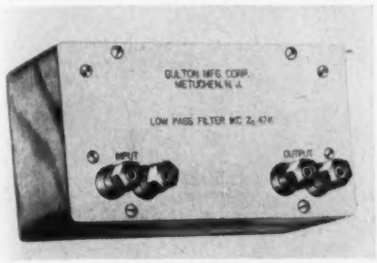


offering high heat resistance and remarkable flexibility. Basic fiberglas braid has been treated to retard fraying and is coated with silicone rubber fused to the braid. The result is a flexible tubing or sleeving with superior resistance to dielectric breakdowns commonly caused by handling and operational stresses. This new insulation meets applicable NEMA Class H specifications and being completely inorganic will not support fungus growth. BH "1151" maintains its flexibility and rated dielectric strength through a temperature range of −90°F. to 400°F. with spot temperature resistance to 600°F. It is available in all standard sizes in NEMA grades H-A-1, H-B-1, H-C-1 and H-C-2 with average rated dielectric strengths of 1,500 to 7,000 volts, BH "1151" is made in natural (off-white) and colors, to aid in circuit tracing and coding; in 36 in. lengths, coils or short pieces cut to individual specifications.—**Bentley, Harris Manufacturing Co., Conshohocken, Pa.**—TELE-TECH.

For Designers and Manufacturers

Low Pass Filters

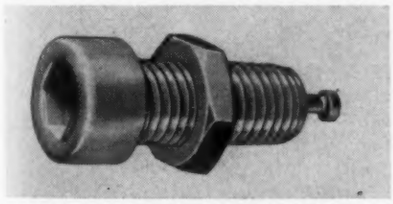
Low attenuation in the pass band, high attenuation in the rejection band, linear phase transfer and high characteristic im-



pedance are featured in a new series of filters. These units are three section, constant K networks designed for general laboratory use but more specifically for use with Glennite accelerometers and cathode followers for shock and vibration measurements. Use of the finest high-Q toroids commercially available results in extremely sharp cutoff characteristics. Attenuation exceeds 55 db in the rejection band. In addition to presenting resistive impedances in the pass band, F-10 filters feature linear phase transfer characteristics that provide undistorted signal outputs in the pass band. The use of large value inductors makes the characteristic impedance of these filters high enough for insertion between two pieces of electronic equipment. Each capacitor is mounted in a walnut case with suitable input and output terminals provided.—**Gulton Mfg. Corp., Metuchen, N. J.**—TELE-TECH

Nylon Tip Jacks

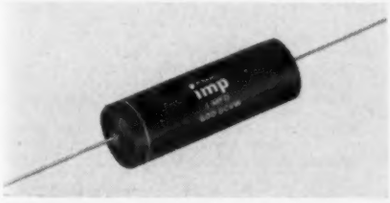
Breakdown rating is 11,000 v. and nominal capacity to ⅛ in. panel is 2.0 $\mu\mu$f in a new line of nylon insulated tip jacks. Silver-



plated contacts, either phosphor bronze or beryllium copper, are supplied. Accepting .081 in. diameter pins, engagement is positive insuring low contact resistance. Minimum withdrawal force is one pound. Integral solder terminals are hot tin dipped. Nylon bodies are available in eleven bright colors and require no insulating hardware. Heads are recessed to avoid accidental contact.—**E. F. Johnson Co., Waseca, Minn.**—TELE-TECH

Capacitor

A new type of molded tubular paper capacitor embodies several extremely rugged characteristics. "IMPS", as the new units are



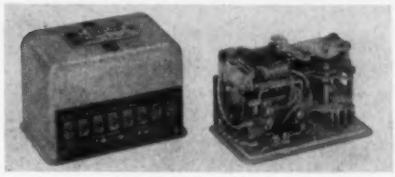
called, are molded of thermosetting plastic which renders the capacitor impervious to moisture and capable of operating at temperatures ranging from −40°C to +100°C. The "IMP", with securely anchored tinned copper leads, will also withstand severe physical treatment. Each section is non-inductively wound, and is available in capacitance values ranging from 0.00025 μf to 0.5 μf in a 200 and 400 v. ratings, and from 0.00025 μf to 0.25 μf in a 600 v. rating.—**Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.**—TELE-TECH

Oscillograph Accessories

Four accessories for PM-18 portable oscillograph for recording several changing voltages simultaneously are: 1) continuous-drive film holder for long record applications; 2) viewing attachment for observing waveform before recording; 3) galvanometer with sensitivity of 1.67 mm/μ a at one meter; 4) sweep mirror which provides adjustable time sweep of 0.1 to 0.5 sec. in addition to original non-adjustable 1/60-sec. sweep.—**General Electric, Meter and Instrument Dept., Schenectady 5, N. Y.**—TELE-TECH.

Time Delay Relay

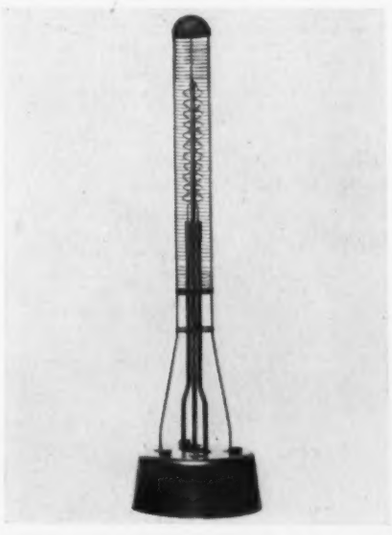
Model 523-A is a sustained operating impulse, immediate switch throw, delayed time cycle relay. The timer is wound practically instantaneously (0.025 to 0.10 sec., varying



with coil arrangement and loading) as control circuit is energized; switch throws over immediately. Time delay period begins when control circuit is broken, but switch remains thrown over until expiration of time cycle, when switch returns to original position. Unit is then ready for re-cycling when control circuit is restored. Should the circuit be restored before expiration of time delay period because of natural or planned interference, the 523-A instantaneously rewinds and restores total time delay period without disturbing thrown-over position of switch.—**M. H. Rhodes, Inc., Hartford, Conn.**—TELE-TECH

Improved Grid Structure

An improved grid structure that minimizes one of the primary causes of premature vacuum tube failure—filament-to-grid shorts



—is a feature of the redesigned F-891 and 892 broadcast tubes. A double helix filament has been incorporated in this type, replacing the conventional hairpin structure. The double helix is wound through 360° for mechanical stability and carries opposing electrical fields, resulting in improved electrical performance. The new design has been completely checked and subjected to repeated filament cycling tests equivalent to three years' operation in normal broadcast equipment. The 891 and 892 tubes of the three-electrode type are designed for use as modulator, amplifier, and oscillator.—**Federal Telephone and Radio Corp., Clifton, N. J.**—TELE-TECH

Germanium Diodes

A new range of tapered germanium diodes, featuring "polarity at a glance," provide the ruggedness and moisture resistance required

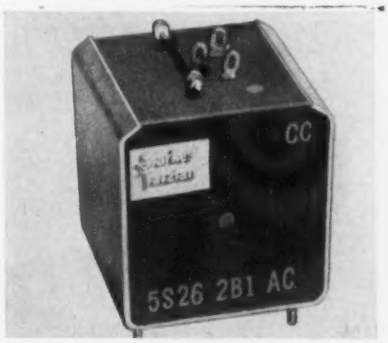
by the military in a low-cost high-production structure. Because of the simplicity of the design, the same components and moisture sealing processing are used in inexpensive commercial types as are used for JAN units. Careful germanium processing, using specially developed techniques, assures long life and high stability. The unit consists of a germanium wafer soldered to a nickel alloy cathode pin, and an electro-etched tungsten whisker welded to a nickel alloy anode pin, assembled into a glass-phenolic body. The entire assembly is positively impregnated with a special polyethylene compound using the vacuum-pressure method. The diode may be clip mounted by the terminal pins, or soldered in by the rugged copper-tin clad iron "pigtail" leads which are welded into the pins. The tapered hexagon shaped body shows polarity at a glance, speeding up assembly operations, reducing assembly error, and greatly facilitating visual inspection. Large-figure permanent marking is provided on the flats of the hexagon so that type numbers are clearly visible even after much handling. The hexagon shape permits mounting against a flat surface with positive orientation so that the type number can be held up in a clearly visible position.—**Radio Receptor Co., Inc., 251 West 19th St., New York 11, N. Y.**—TELE-TECH

Magnetostriction Oscillator

Magnetostriction oscillator for testing the effect of sound energy on different materials is available in 50 and 200 watt models, having test capacities of 66 cc and 165 cc, respectively. Device is composed of three parts: driving element, stand containing drive coil, and rod-and-cup assembly. In operation, laminated nickel rod oscillates longitudinally in ac magnetic field, causing diaphragm which forms bottom of cup to vibrate.—**Raytheon Mfg. Co., Dept. PR-6270, Waltham, Mass.**—TELE-TECH

Embedded Selenium Rectifiers

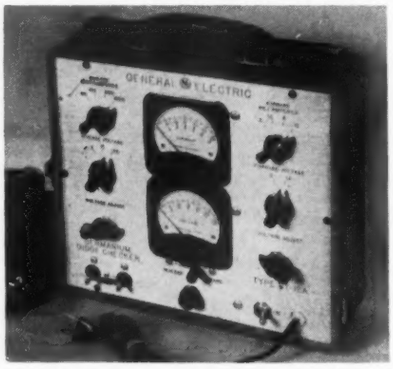
Embedded selenium rectifiers, available in many sizes, and designed for use in military equipments will meet all specifications on en-



vironmental conditions, shock, acceleration and high altitude operation. The typical unit illustrated will deliver the same dc power as a hermetically sealed-can enclosed rectifier that weighs 1.8 lbs. and measures 7¼ x 4¼ x 4¼ in. The illustrated rectifier will deliver 40 v. dc at 1 amp under continuous operating conditions.—**Rectifier Division of Sarkes Tarzian, Inc., 415 North College Ave., Bloomington, Ind.**—TELE-TECH

Germanium Diode Checker

Type ST-12-A germanium diode checker has test clips for diodes using leads, and for those with pins on each end. Should test



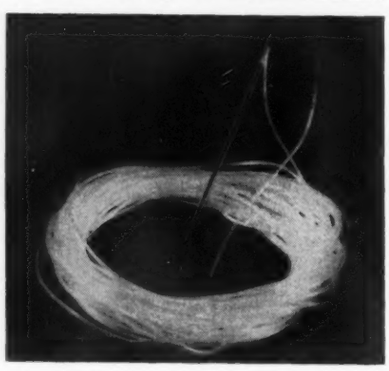
clips be shorted on any range, the circuit is designed to prevent instrument damage. Diode resistance is checked by placing a variable, accurately metered dc voltage across the diode. The resulting current appears on a second meter. The forward and inverse circuits are entirely separate. A diode may be checked to test limits in both the forward and back direction by moving a lever switch; thus eliminating both reversal of the diode in the clips and any major readjustments of controls. A three-in. voltmeter and three-in. current meter permit voltage and current to be metered simultaneously. All voltage ranges are continuously variable. A chart of manufacturer's limits for about 40 of the most commonly used diodes is secured in the cover.—**Dept. N-12, General Electric Co., Electronics Park, Syracuse, N. Y.**—TELE-TECH

Voltmeter

The maximum sensitivity ratings of model 314 voltmeter were incorrectly stated on page 68 in the July issue. This text should have read: Model 314 electronic voltmeter measures ac voltages from 100 μv to 1000 v. in the 15 CPS to 6 MC frequency range. Its accuracy of 3% up to 3 MC and 5% above is the same at all points on the single logarithmic voltage scale. With its probe, the input impedance is 6 $\mu\mu$f shunted by 11 megohms and the voltage range is 1 mv to 1000 v. in 6 decade ranges. Without its probe it may be used to measure down to 100 μv but the input impedance is reduced to 25 $\mu\mu$f shunted by 1.1 megohms. Stabilization is accomplished by the generous use of negative feedback. One of its features is the unique probe which has a self-holding connector tip and also a group clamp especially designed to insure a low impedance ground return. It may also be used as a wide band amplifier with maximum gain of 60 db variable in 20 db steps and flat within ½ db from 100 CPS to 3 MC and within 1 db from 50 CPS to 6 MC.—**Ballantine Laboratories, Inc., Boonton, N. J.**—TELE-TECH

Extruded Plastic Tubing

An extremely fine diameter extruded plastic tubing (.12 in. I.D. x .012 in. wall) is a new wire covering for use in miniature



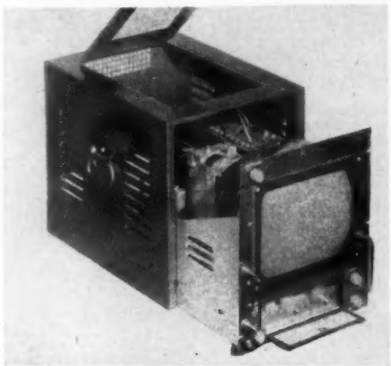
motors, relays, capacitor leads and similar applications. Regardless of its small diameter, all the physical characteristics of the manufacturer's regular Temflex 105 and Transflex tubing are maintained. Samples will be sent on request.—**Fibron Division, Irvington Varnish and Insulator Co., Irvington, N. J.**—TELE-TECH

Actuator Metal for Precision Switches

Precision miniature switches which will open and close as many as 100 million times can be manufactured with a new type of alloy known as Armco 17-7 PH (precipitation hardening) stainless steel. Operating clearances in these switches are often critically small, and even a slight change in position of the actuator may render the switch useless. Drift characteristics of 17-7 PH stainless are reported to be superior to any other material tested. Switch life has also been greatly lengthened because of the exceptional flexure endurance of the metal. Another advantage is marked corrosion resistance, which further contributes to long, dependable service. Some standard types of stainless steels, while durable, have poor spring characteristics when soft enough to form properly. They take a permanent set after relatively few operations. Other standard types of stainless with good spring characteristics will crack when severely worked. 17-7 PH stainless has solved these problems, according to the manufacturer.—**Micro Switch Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.**—TELE-TECH

Picture Monitors

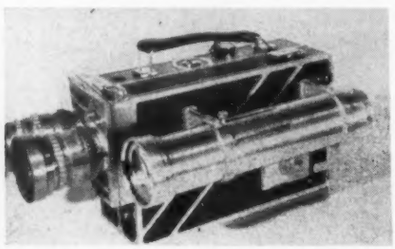
Available in cabinet and rack mountings, new line of TV picture monitors may be obtained with 8, 10, 12, 14 or 16 in. picture



tubes. Multiple string of units may be hooked up using cathode follower connections. Representative of monitor series is the cabinet and panel combination model CP112X with 12LP4 tube. Frequency response is 6 mc ± 1 db, and horizontal resolution is 500 lines or better. Input signal to terminated or bridge input is 0.5 to 4 v. peak-to-peak. Plug-in capacitors effect speedy replacement. Cabinet is 20 x 20 x 16 in. and weighs 96 lbs. total.—**Television Utilities Corp., 1315 Jericho Turnpike, New Hyde Park, N. Y.**—TELE-TECH

Motion Picture Camera Zoom Type View Finder

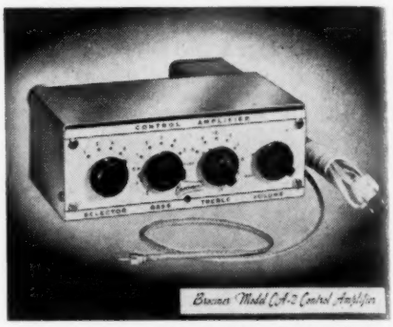
A new zoom type view finder magnifies the image in the field of view as the focal length of the finder is adjusted, and is de-



signed for Eastman Cine Kodak model 1 and 11. This finder will zoom from 15mm field to 152mm. A parallex compensating peep sight eyepiece is incorporated on the viewing end of the tube, with parallex positions calibrated. When using 15mm field, the front element adaptor lens is removed from the finder, but for all other lens fields from 25mm to 152mm, the front element lens adaptor remains on the front of the finder tube. Brackets for mounting the finder on the door of the 100 ft. or 200 ft. magazine are supplied wtih this unit. A template for mounting the brackets is included. Price $75, FOB New York.—**Camera Equipment Co., 1600 Broadway, New York, N. Y.**—TELE-TECH

Remote Control Equalizer-Amplifier

Model CA-2 control amplifier is a self powered remote preamplifier, providing the following controls: input selector; bass boost



and cut control; treble boost and cut-off control; volume and on-off control. Step type controls provide carefully graded equalization over a wide range, with calibrated flat positions. A cut-off filter treble control permits elimination of noise and distortion in program material with minimum loss of quality of reproduction. The bass control affords bass boost and bass reduction. Frequency response is 20 CPS to 70 KC, ±1 db. Hum and noise level are 70 db below nominal 2 v. output, at full gain. Noise level decreases with reduction in gain. List price: $125.00 f.o.b. factory.—**Brociner Electronics Laboratory, 1546 Second Ave., New York 28, N. Y.**—TELE-TECH.

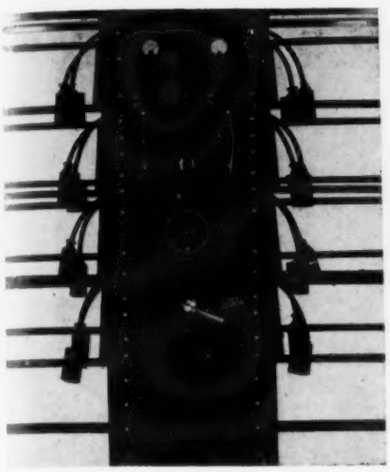
Roller

A new, hand-operated slip roll will form complete circles in 16 gauge steel in ⅓ less the time it ordinarily takes and also forms bends at any point in a sheet of material. An

exclusive feature of the machine is a cam actuated idler roll. Because of it, complete circles of one in. diameter or larger can be formed in two passes through the rolls; something that usually takes several passes. In "two pass circle forming," the cam operating lever lowers the idler roll to allow insertion of the material. It also raises the roll to a pre-set position which determines the diameter of the circle to be formed. On the first pass through the roller a half circle is formed, and on the second pass the circle is completed. In addition parts can be duplicated with great accuracy and at high rate of production since the idler roll always returns to its pre-set position. Circles of one in. diameter only can be formed in just one pass through the roller by making slightly different adjustments. Round, flat and square stock as well as many other ductile materials can be formed with this precision machine. Maximum material forming capacity of the roller is ¼ in. round steel bar and ¼ in. tubing or their equivalents. Special rolls will be supplied for special bending jobs. The Di-Acro roller is available in two sizes. The No. 1 roller forms material up to 6 in. wide. The No. 2 roller forms material up to 12 in. wide. Both machines will form material to a one in. diameter or larger. Sample material with specifications may be submitted to the manufacturer for test forming or sample duplication.—**O'Neil-Irwin Mfg. Co., 624 Eighth Ave., Lake City, Minn.**—TELE-TECH

Vacuum Tube Aging Rack

Simultaneous ac aging of up to 400 vacuum tubes can be accomplished by the model TS-2 aging rack. All switches and controls are



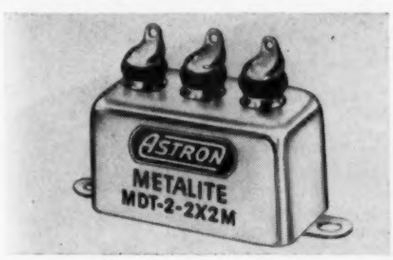
mounted on the control panel. Individual switching is provided, permitting one rack to be loaded or unloaded while the other is operating. There are separate tube socket connections for right and left racks. Test panels are removable. Other features include: heavy duty continuously variable filament supply; one or more adjustable timers with automatic buzzer; interlock protection.—**General Electrosonics, Inc., 32 West 22nd St., New York 10, N. Y.**—TELE-TECH

Combination Resistor-Fuse

The "Fusistor" is a resistance unit that under normal electrical load will operate as a resistor only, but when it is subjected to an overload of current, will sustain the overload for a predetermined time, then melt or burn out before expiration of another given predetermined time. For example, the "Fusistor" can be built to carry an overload for a minimum of 20 seconds, then fuse or burn out within the next 30 seconds. The overload time-lag can be established within closely controlled minimum and maximum time limits. There is no spewing of flame, or spark emission, at the moment of fusion. —**Milwaukee Resistor Co., 700 W. Virginia St., Milwaukee 4, Wis.**—TELE-TECH

Silicon Rubber Bushings

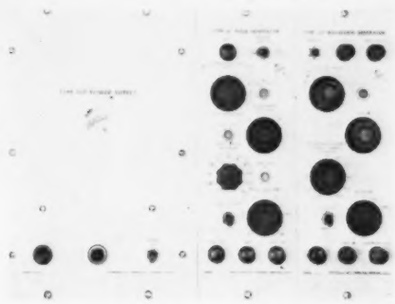
Silicon rubber bushings are now used as standard terminal construction on all hermetically-sealed bathtub-type and can-type



Astron capacitors with rivet lug terminals. Silicon rubber bushings are said to provide a more positive hermetic seal as well as bearing approval of the Armed Forces as the preferred terminal construction.—**Astron Corp. 255 Grant Ave., East Newark, N. J.**—TELE-TECH.

Special Waveform Generators

Type 160 regulated power supply, type 161 pulse generator and type 162 waveform generator provide precision waveforms with controllable characteristics. The 160 power supply is capable of supplying the necessary ac and regulated dc voltages to operate six of the other two units in any combination. It is completely regulated to compensate for line voltage fluctuations over the range of 105 to 125 v., and for changes in load. The type 161 pulse generator supplies rectangular pulses of known and variable amplitude and duration, of either positive or negative polarity. A positive gate of the same duration as the pulse, and a delay facility are available. The type 162 waveform generator provides a linear sawtooth waveform, a positive gate, and a positive trigger. The operation can be gated, triggered or recurrent and can also be controlled by a push button, remote or on the panel. In recurrent operation the repetition rate of these waveforms is variable. The instruments are combined easily to provide pulse conditions of almost any desired degree of complexity. By proper manipulation, "bursts" or groups of rectangular pulses provide tetanus stimulation. Pulse groups are variable as to the number of pulses in the group and group repetition rate, as well as to the amplitude, duration and



repetition rate of the individual pulses. As the number of units is increased, rectangular pulse combination with more complex characteristics can be obtained to meet other requirements. The physical dimensions are such that a power supply and six units fit conveniently into two 12¼ x 19 in. standard relay racks, by means of special mounting frames.—**Tektronix, Inc., Portland 7, Ore.**—TELE-TECH

Decade Box

A new approach to precision variable resistors and voltage dividers is available in the line of Dekapots which features the "Beco Dekadial." An effective scale length of more than 400 in. permits highly accurate and reproducible settings. This dial selects the proper combination of precision fixed resistors and a supplementary precision variable resistor to obtain the desired value. The Dekadial may be read directly to four places and a fifth place may be estimated. Overall accuracy of better than 0.05% of full scale is

maintained in the units. Cased Dekapots suitable for general laboratory use are available as stock items. Dekapots suitable for panel mounting as components of other equipment can also be provided.—**Brown Electro-Measurement Corp., Dept. TT-2, 4635 S. E. Hawthorne Blvd., Portland 15, Ore.**—TELE-TECH

Equipment Dolly

A sturdy dolly, designed to facilitate the moving of heavy racks and cabinets, measures 21 x 22 in., is made of steel in black wrinkle finish, and is fitted with four ball-bearing, easy-swiveling casters. It is especially useful in laboratories and radio and TV stations, where test instruments, oscilloscopes, transmitters and receivers must be shifted often from one floor position to another. The new Insuline rack dolly carries the catalog number 4086. Price is $9.60.—**Insuline Corporation of America, 36-02 35th Ave., Long Island City 1, N. Y.**—TELE-TECH.

Standard Tape-Speed Portable Recorder

Independent of ac lines, wet batteries, and chargers, the Tapak tape recorder operates at standard voice speed of 7½ in./sec. It

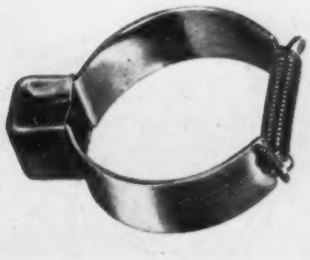
erases, records, monitors, plays back to a headset, incorporates fast power-rewind, and has a built-in editing fixture. On remote locations, it turns out finished continuity ready for airing on station or studio tape equipment. A novel tape-drive eliminates clutches or belts, drives tape and take-up reel simultaneously with a rubber idler wheel which is rotated by a 78 rpm capstan. The Tapak records continuously for 15 minutes on 5 in. reels of red oxide tape, runs 5-6 minutes per winding, and may be rewound while running. Indicators warn when winding is needed. Drive mechanism is shiftable to fast reverse without rethreading. It will operate with cover closed using external stop-start control. Mike, headset, spare reel and splicing tape fit inside case. Pivoting knob-shaft converts carrying handle into winding crank. Two flash cells and one 67½ v. B bat., accessible through outside door, power the Tapak amplifier. A battery tester is built in. Flash cells last 20 hours; B bat., 40-80 hours.—**Broadcast Equipment Specialties Corp., 135-01 Liberty Ave., Richmond Hill 19, N. Y.**—TELE-TECH

Phenolic Molding Material

Corrosion of silver contacts due to a chemical commonly used in the production of many phenolic plastics is claimed to be eliminated in a new material called Durez Black. It is a general-purpose-type phenolic and has the same molding characteristics and physical properties as those currently being used in the average electrical application.—**Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y.**—TELE-TECH

Ion Trap

A new low-priced slip-on ion trap incorporates simplified steel construction which lowers manufacturing costs by fully utilizing the maximum efficiency of the Alnico per-



manent magnet. According to the manufacturer, this makes model T-312 the lowest-priced ion trap available. Each trap is stabilized and tested on special equipment designed for this purpose. Installation time is 2 or 3 seconds. The smooth metal-to-glass contact permits easy adjustment. Model T-312 stays put without wobble or shift during shipment of the completed TV sets. It is also light in weight, 3/5 oz., so the tube's neck cannot be harmed. Gauss readings range from 25 to 60.—**Heppner Manufacturing Co., Round Lake, Ill.**—TELE-TECH

"WESCON - - 1952"

West Coast manufacturers and engineers convene August 27-29 for annual event at Long Beach, Calif.

The 1952 Western Electronic Show and Convention, termed WESCON, will open its doors in the municipal auditorium at Long Beach, Calif., on August 27 for a three day period. WESCON, as a trade show, will present the largest display of diversified products ever seen in the West. Over 300 makes will be displayed in more than 200 booths. As an IRE convention, twenty-seven Technical Sessions are programmed embracing papers, panels, and symposiums on subjects encompassed by twelve of the sixteen national IRE professional groups. An "all-industry" cocktail party, 5-7 pm on Aug. 27, and the Luncheon at noon on Aug. 29, both to be held in the Marine Room of the Wilton Hotel, comprise the main social events.

Of especial interest also, is the all day symposium to be jointly conducted by the IRE and AIEE Professional groups on Telemetry and Remote Control. This will take place at the Lafayette Hotel in Long Beach on Tuesday Aug. 26 just preceding the main convention.

Titles of technical papers scheduled for presentation, names of the authors and their company affiliations are shown below.

See page 114 for list of exhibitors

TECHNICAL PAPERS PROGRAM

WEDNESDAY, AUGUST 27

I—Broadcast & TV Receivers

"High Efficiency, Low-Copper Sweep Yokes with Balanced Transient Response"—C. E. Torsch—General Electric Co.
"A Combination UHF-VHF Tuner"—H. A. Finke and S. Deutch—Polytechnic Research & Development Co.
"Manufacturing Techniques of I-F and R-F Coils and Transformers"—Barney Goldsmith—Essex Electronics
"Potential Uses of Glass Components in Television Receiver Design"—H. S. Craumer—Corning Glass Works
"Television Sweeps"—Byron M. Cole—Brubaker Manufacturing Company

II—Airborne Electronics

"Penalty of Electronics in Aircraft"—C. E. White—Republic Aircraft Co.
"Dependable Electron Tubes"—J. Walter Creer—Bureau of Ships
"Electron Tube Failures in Military Electronic Equipment"—C. R. Knight—Aeronautical Radio

III—Electronic Computers

"A Digital Computer for Airborne Control Systems"—Eldred Nelson—Hughes Aircraft Co.
"A Five Tube, Three Megacycle Counter Decade"—Robert M. Strassner—Consolidated Engineering Corp.
"Static-Dynamic Design of Flip-Flop Circuits"—C. L. Wanlass—North American Aviation, Inc.
"Applications of CRC-105 Decimal Digital Differential Analyzer"—Eric Weiss—Computer Research Corp.
"Multidimensional Magnetic Memory Selection Systems"—M. K. Haynes—International Business Machines Corp.

IV—Radio Telemetry & Remote Control

"Data Reduction Methods for Radio Telemetering Systems"—E. Donath and J. F. Brinster—Applied Science Corporation of Princeton
"A Special Purpose Digital Telemetering System"—C. A. Piper—Bendix Aviation Corp.
"Special Non-Standard Telemetering Problems"—Marcus D. O'Day—Air Force Cambridge Research Labs
Panel—Telemetering Practice and Problems

V—Broadcast and Television Receivers

"The NTSC Color Television Signal—A. V. Loughren and D. E. Foster—Hazeltine Corporation
"Nature and Status of Compatible Color Television"—Dr. R. M. Bowie—Sylvania Electric Products, Inc.
Symposium—"Color Television—Its Present Status and Future"

VI—Electronic Computers

"Analog Computer Simulation of an Airplane Pilot"—S. R. Mayne and R. Mead—Goodyear Aircraft Corp.
"An Automatic Cruise Control Computer for Long Range Aircraft"—J. R. Shull—J. B. Rea Company, Inc.
"A Stabilized Electronic Multiplier"—C. D. Morrill and R. V. Baum—Goodyear Aircraft Corp.
"The Michel Recording System"—J. T. Potter and Dr. P. C. Michel—Potter Instrument Company, Inc.

VII—Airborne Electronics

"Two Special Types of Wide-Band UHF Antennas"—F. D. Clapp and R. W. Bickmore—University of Calif.
"Current Distribution on Wing-Cap and Tail-Cap Antennas"—Irene Carswell Reese—Stanford Research Institute
"Airborne Miniature Phantom Target for Short Range Radar Applications"—Tore N. Anderson—Airtron, Inc.
"Heat Transfer in Aircraft Electronic Equipment"—D. T. Drake—North American Aviation

VIII

"The C-1 Alarm and Control System for Use with Microwave Radio Relay"—Harold M. Pruden—Bell Telephone Laboratories
"Telemetering Needs of Petroleum Producing Operations"—L. A. M. Barnette—Humble Oil and Refining Co.
"Telemetering for Electric Utility Substations"—W. F. Clare—Southern California Edison Co.

THURSDAY, AUGUST 28

IX—Antennas and Propagation

"The Nature of Gradient Reflections"—Joe Feinstein, National Bureau of Standards
"The Insignificance of Continuous Internal Reflections in Tropospheric Propagation Beyond the Horizon"—Martin Katsin, Naval Research Laboratory
"A Criticism of the Feinstein-Carroll Theory of Tropospheric Propagation"—H. G. Booker and W. E. Gordon, Cornell University
"Meteorological Effects on VHF Propagation"—W. G. Albright, E. C. Jordon, and K. Toman, University of Illinois

X—Electron Devices

"Oscillators Utilizing Wave-Type Tubes"—J. R. Whinnery and H. R. Johnson, Hughes Aircraft Co.
"Theoretical and Experimental Performance of Traveling Wave Tubes at Large"—Lester M. Field, Stanford University
"Electron Stream Amplifiers with Boundary Walls of Complex Admittance Analysis and Experiment"—C. K. Birdsall, G. R. Brewer, and J. R. Whinnery, Hughes Aircraft Co.
"A Folded Line Space Harmonic Amplifier for Centimeter Wavelengths"—J. L. Putz, K. R. Spangenberg, Stanford University
"The Effect of Filament Voltage Upon Vacuum Tube Characteristics"—A. J. Winter, Telecomputing Corporation

XI—Nuclear Science

"Pulse Equipment for Receiving Radio Echoes From The Atomic Nucleus"—L. Malling, Varian Associates
"A 40 Channel Pulse Height Analyzer"—R. E. Heller, University of California
'Measurement of High Intensities of Radiation by Use of Pulsed Geiger Tube Operation"—S. W. Lichtman, Naval Research Laboratory
"Microwave Oscillographs"—R. Kompfner, Bell Telephone Labs.

XII—Information Theory

"The Development of Information Theory"—W. R. Bennett, Bell Telephone Labs.
"Analog Computing Applied to Noise Studies"—R. R. Bennett, Hughes Aircraft Co.
"New Techniques in the Mathematical Analysis of Random Noise"—R. C. Davis, U.S.N. Ordnance Test Station
"Applications of the KAC-Siegert Method for Finding Output Probability Densities for Receivers with Square Law Detectors"—R. C. Emerson, Rand Corporation

XIII—Broadcast and Television

"A Video Magnetic Recording System"—Jack Mullin, Bing Crosby Enterprises
Symposium—"What the End of the TV Freeze Means to the West Coast"

XIV—Antennas and Propagation

"Propagation Characteristics of Microwave Optical Links"—L. G. Trolese, J. P. Day and R. U. F. Hopkins, U.S. Navy Electronics Laboratory
"Microwave Radio Reflection from Ground and Water Surfaces"—A. W. Straiton, University of Texas
"Short Period Sky-Wave Fading of CW Emissions"—H. P. Hutchinson, U. S. Army Signal Corps

XV—Instrumentation

"Electrical Noise in Wire-Wound Potentiometers"—Irving J. Hogan, Helipot Corporation
"Automatic Ultrasonic Flat Plotting Equipment"—D. C. Erdman, Electro Circuits, Inc.
"Performance Evaluation of Special Red Tubes"—H. J. Prager, Radio Corp. of America
"The Methods of Analysis of Magnetic Amplifier Systems"—L. A. Finzi and G. F. Pittman, Jr. Carnegie Institute of Technology

XVI—Electron Devices

"Present Status of the Semiconductor Program"—K. Lark-Horovitz, Purdue University
"Transistor Characteristics"—H. M. Zeidler, Stanford Research Institute
"The Application of RCA Point Contact Transistors"—R. M. Cohen, Radio Corp. of America
"Recent Developments in Diffused Junction Transistors"—J. S. Saby, General Electric Co.
"A Transient Equivalent Circuit for Junction Transistors"—N. H. Erenstein, Hughes Aircraft Co.

XVII—Data Handling Systems Symposium

"Key Note Address"—Dr. R. D. Huntoon, National Bureau of Standards
"Organization of Data for an Automatic System"—D. V. Savidge, Remington Rand, Inc.
"Problems of a High-Speed Data-Handling System"—E. E. Green, U. S. Naval Ordnance Test Station

XVIII—Engineering Management

"Engineering as Something to Sell"—E. Finley Carter, Sylvania Electric Products Inc.

(*Continued on page* 119)

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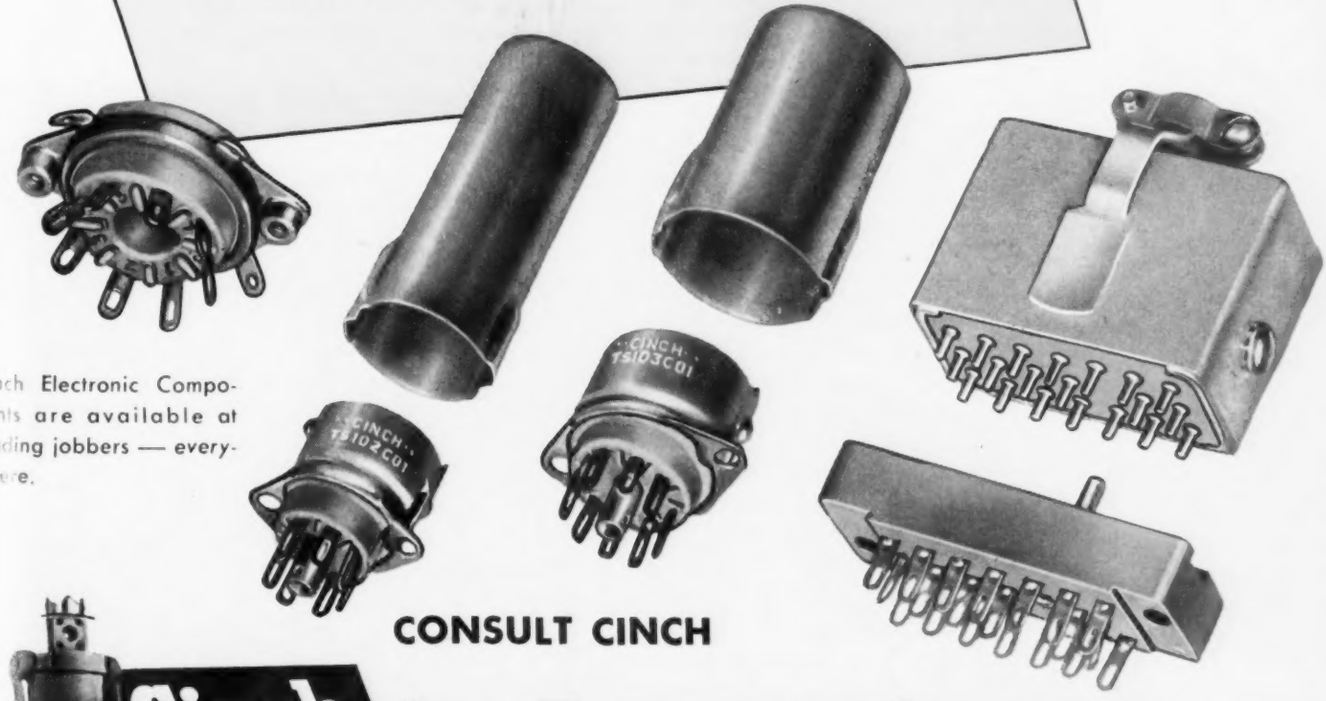

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WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

TV PROCESSING STARTS—The FCC has commenced its history-making and tremendous task of processing the applications for new television stations. During July there were relatively few approvals of TV station construction permits because the commission staff had to undertake an analysis of the engineering, legal and financial aspects of each new station request and this, necessarily, is a time-consuming procedure. The FCC staff has now listed the relative positions of the applications on its "processing line" in the different classes of video stations. Of course, there are four classes of TV applications which will not necessitate hearings—the non-commercial educational requests; the TV stations in the U. S. Territories of Alaska, the Hawaiian Islands, Puerto Rico, etc.; the cities without any television service at the present time; and UHF assignments in communities where only UHF channels are available. The construction permit grants will be expedited by the FCC without hearings wherever possible. Educational station applicants necessarily are slow in preparing their filings because of their requirements of obtaining local, county and state authority and appropriations for establishing such stations.

REVISE PROCUREMENT PRACTICES—Military procurement practices and regulations for the electronic and radio industry are now being reviewed to remedy some of their complications and unnecessary restrictions on the manufacturers which cause additional expenses to the manufacturing companies and thus lead to higher costs for equipment and services by the industry. Under study are the ideas of a "single package" contract, the redetermination clause and the need for "freezing" component designs wherever possible. The subjects of fixed price contracts and advertised bids and negotiated bids, together with the escalator clause and insufficient time between bid and quotation are also being analyzed by the military services and the Munitions Board to evolve more practicable and realistic procurement policies.

NON-INTERFERING 72-76 MC PLAN—After thorough consideration of the effects, interference-wise that industrial and safety radio communications in the 72-76 MC frequency band may have on television stations included in the recently released FCC TV assignment plan, Commission staff members have stepped up processing activity on applications for stations in this band in those cases where the requested facilities are to be located far enough from channel 4 and 5 television assignments so as to constitute no threat to interference-free TV operation. An overall plan for this band will be completed by the FCC shortly which is designed to derive the maximum benefit from the use of 72-76 MC frequencies with a minimum of interference to television facilities.

COLOR TV PRODUCTION—With the modification by the National Production Authority of the ban on manufacture of home color television receivers, the requirement that in applying for color TV set manufacture the companies must show that color TV equipment production will not impair the national defense mobilization effort. In addition, the manufacturer must submit proof that he has made a substantial investment in color TV development as well as showing there will be no diversion of electronic technicians and other skilled personnel from defense work, that proposed color TV production will not prompt refusal of government defense contracts; and that no additional controlled materials will be needed. The Radio Corporation of America, meanwhile, has asked permission from the FCC to conduct field test telecasts of the RCA all-electronic color TV system during regular telecasting hours.

MOBILE RADIO IMPORTANCE—Despite the record heat waves that make the offices housing the FCC Safety & Special Radio Services Bureau staff almost uninhabitable, the FCC is processing weekly hundreds of applications in the multi-phased mobile radio services, now most valuable for almost every segment of industry, transportation and local police, fire and other safety services. TELE-TECH is publishing an authoritative article on the growth and development of the mobile radio services which show their importance to the nation's business, industry, transportation and public safety operations.

GOOD CHANCE FOR EARLIER THEATER TV HEARING—The starting date of the theater television hearings which had been postponed previously five times is now sought to be set for either Oct. 13 or Oct. 20 instead of the presently-slated date of Jan. 12, 1953, by the Motion Picture Association of America and the National Exhibitors' Theater Television Committee. Engineering and accounting testimony can be completed in eight hearing days, the motion picture TV groups cited. The theater TV presentation will include the technical requirements and standards for theater television; sample theater TV microwave distribution systems, including systems illustrative of intercity relay, intercity multiple address and intracity distribution; and theater TV projection equipment, including kinescope projection, film storage and eidophor. The motion picture industry witnesses also will submit in their technical testimony discussion of video signals, including video bandwidth; signal-to-noise ratios; recommended standards for theater TV video transmission systems; etc.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

ANOTHER MAJOR ACHIEVEMENT IN CAPACITOR DEVELOPMENT...

in 1952 AEROFILM* Capacitors

The development of Mylar** polyester film by Du Pont chemists and its adaptation as a capacitor dielectric by Aerovox engineers, presents challenging potentialities in the field of electronic capacitors.

Known as Aerolene Capacitors, these latest components permit higher operating temperatures without corresponding increase in size, as well as unusually high insulation resistance. Both gains mean much to the designers of tomorrow's fantastic weapons and again to peaceful electronic applications. Thus in 1952 Aerovox auspiciously embarks upon its fourth decade of capacitor craftsmanship.

*Aerovox Trade Mark **Du Pont Trade Mark for polyester film

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TELE-TECH's NEWSCAST

Kaiser-Sanders Enters Electronic Field

Kaiser Mfg. Corp., Willow Run, Mich., a wholly-owned subsidiary of Kaiser-Frazer Corp., has established the Kaiser-Sanders Electronics Division, with headquarters in Nashua, N. H., and leased a plant there as the first step in the Kaiser organization's entrance into the electronic field.

Sanders Associates, Inc., Waltham, Mass., a nationally known firm already established in the electronic industry, has sub-leased space from Kaiser and will move its research and development laboratories to the new facility. Sanders Associates, Inc., engineering staff, together with the production organization of Kaiser, will make up a group capable of research, development and production in the electronic field. The initial engineering group to use the new facility will be composed of approximately 100 people.

Air Force Distributes New CEI Instructions to Offices

The Air Force has announced the publication of the Communications-Electronics Instructions (CEI), covering the operations, doctrine, planning, systems and equipment used in USAF installations. An attempt has been made to centralize much of the information found in numerous manuals, technical orders, letters, regulations and joint publications.

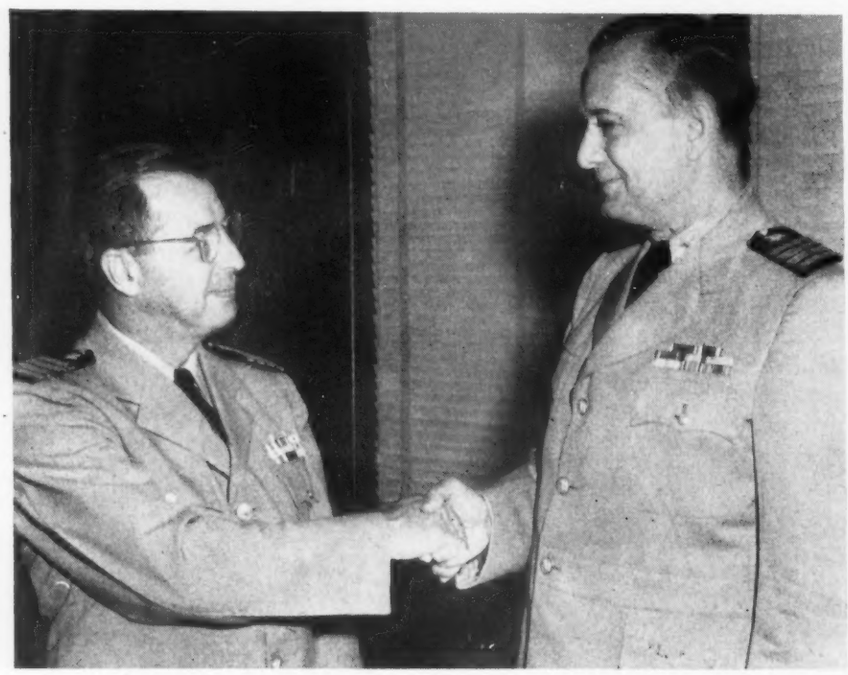
The CEI, first document of its kind, will be distributed throughout the various Air Force C-E offices, and is expected to serve as a basis of indoctrination and reference for new personnel. Revision and improvement of this first issue will be accomplished by a succeeding series of publications, which will keep abreast of changes in the art.

More than 5 to 1 Parts Reduction in New Relay Design

Shown at right is a closeup of a completely new telephone relay utilizing radically new design techniques. Developed by Bell Laboratories for manufacture by Western Electric Company's Hawthorne Works in Chicago, the new units will be in production next year. In the new relay the narrow strips of flat spring metal contacts assembled in layers about the electromagnet have been eliminated. Instead, lengths of round spring wire are employed. These wire springs are held in place securely and accurately by a plastic block into which they are molded. As a result of this design the number of relay parts

required has dropped from 70 to as few as a dozen. The new type relay can control as many as 24 different functions at the same time and can operate in less than 0.003 sec.

NAVAL ELECTRONIC OFFICIALS EXCHANGE COMMANDS



Captain Willis H. Beltz, USN, (Right) is greeted by Captain Frederick R. Furth, USN, at the Naval Research Laboratory in Washington, D. C. Captain Beltz is the new director of the Laboratory and Captain Furth relieves Captain Beltz as Assistant Chief of the Bureau of Ships for Electronics.

Coming Events

August 19-22—1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.

August 26—September 6—British National Radio Show, Earls Court, London, England.

August 27-29—Western Electronic Show & Convention, WCEMA and IRE, Long Beach, Calif.

September 8-12—ISA, 7th National Instrument Conference and exhibition, Cleveland Auditorium, Cleveland, Ohio.

September 19-20—IRE Conference, Cedar Rapids Section, Cedar Rapids, Iowa.

September 22-25—NEDA, 3rd National Convention, Ambassador Hotel, Atlantic City, N. J.

September 29-October 1—Eighth National Electronics Conference and Exhibition, Sherman Hotel, Chicago, Ill.

October 5-10—SMPTE, 72nd Convention, Hotel Statler, Washington, D. C.

October 21-23—1952 RTMA-IRE Fall Meeting, Syracuse, N. Y.

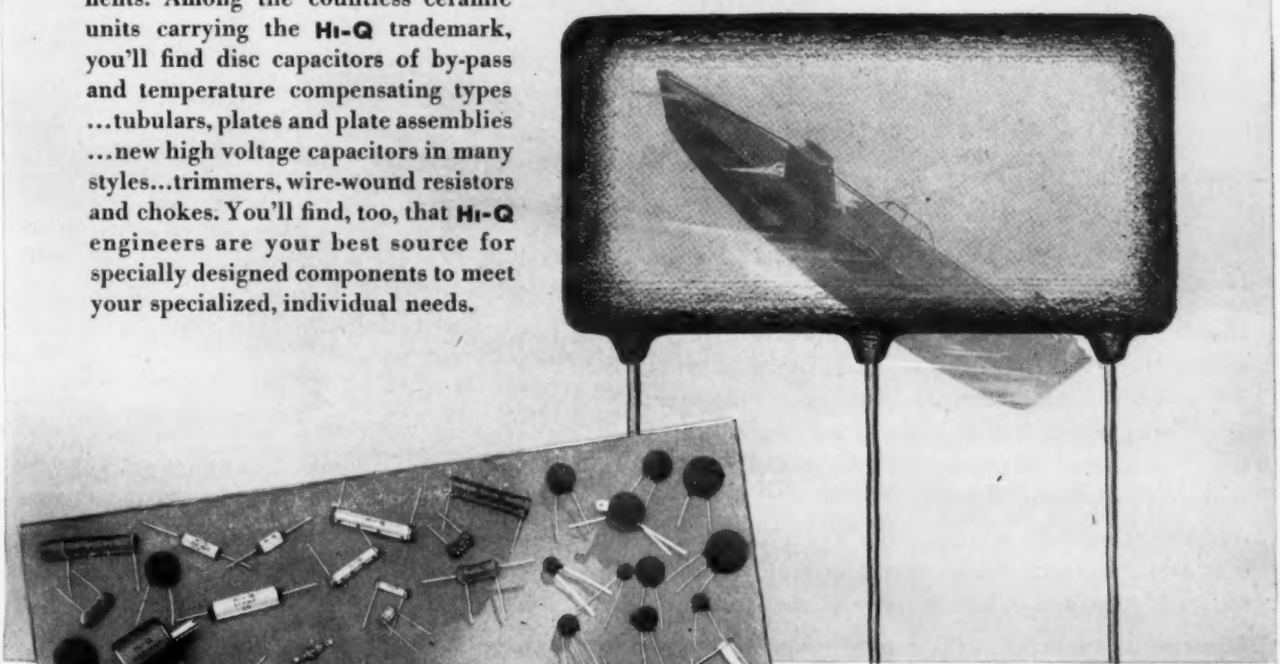
November 5-7—IMS, 16th Annual Time and Motion Study Clinic, Sheraton Hotel, Chicago, Ill.

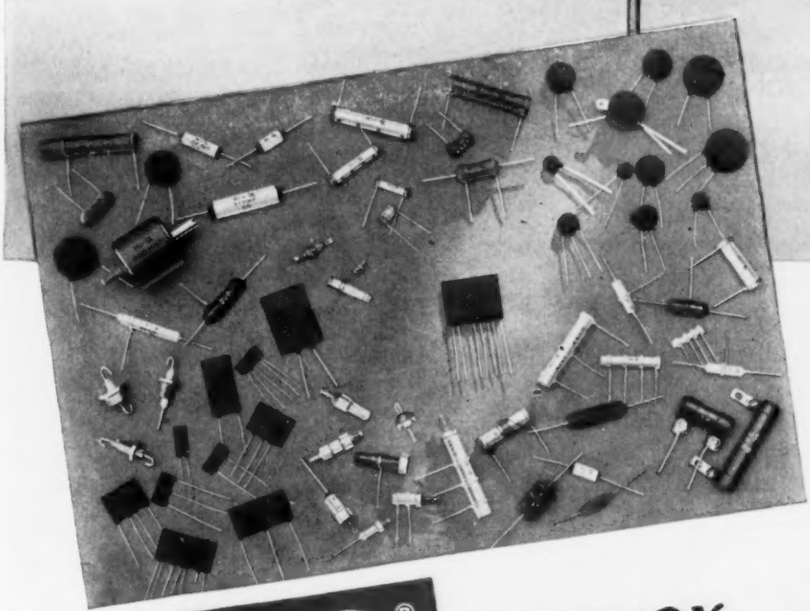
APCO: Associated Police Communication Officers
IRE: Institute of Radio Engineers
IMS: Industrial Management Society
ISA: Instrument Society of America
NEDA: Nat'l. Electronic Distr. Assoc.
RTMA: Radio-Television Mfrs. Assn.
SMPTE: Soc. of Motion Picture and TV Engineers
WCEMA: West Coast Electronic Mfrs. Assn.

HI-Q SERVES NATIONAL DEFENSE

Whenever Electronics Lend Ears to the Fleet

● Among the countless contributions which electronic engineers are making to our armed services, high importance must be placed on long-range eyes and ears for the fleet... ...not only in increasing the deadliness of its own undersea craft, but equally in protecting its surface vessels from enemy submarines. And throughout the field of electronics, high importance is likewise placed on the dependable long life and rigid adherance to specifications found in HI-Q components. Among the countless ceramic units carrying the HI-Q trademark, you'll find disc capacitors of by-pass and temperature compensating types ...tubulars, plates and plate assemblies ...new high voltage capacitors in many styles...trimmers, wire-wound resistors and chokes. You'll find, too, that HI-Q engineers are your best source for specially designed components to meet your specialized, individual needs.





HI-Q PLATES AND PLATE ASSEMBLIES

HI-Q Plate Capacitors can be produced in single and multiple units in an unlimited range of capacities up to guaranteed minimum values of 33,000 mmf per square inch. The number of capacities on a multiple unit is limited only by the K of the material and the physical size. In HI-Q Plate Assemblies (printed circuits) the number of combinations of condensors and resistors which can be incorporated on a single unit is virtually endless...again, limited only by the K of the material and physical size.

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Boroncarbon Resistor

(*Continued from page 49*)

oncarbon and deposited carbon in is respect is equal in the range om 100 ohms to about 2,000 ohms. or higher resistance values, boncarbon shows slightly better erformance. Maximum resistance hange for boroncarbon on this test s shown to be approximately 0.1%. MIL-R-10509 allows a maximum of 0.5%.

The performance data on boroncarbon resistors presented here is the result of intensive qualification testing required to meet the specification of MIL-R-10509. Prior to qualification testing, many thousands of tests were performed to guide development. During the course of development it became apparent that the trend in the design of military electronic gear would necessitate, in many applications, a performance requirement exceeding in severity the specifications of MIL-R-10509. In many respects, therefore, the course of development was modified accordingly. It may be of interest to note that approximately 3,000,000 units were wholly or partially processed in the course of the development. Of this quantity, approximately 100,000 were carried through one or more stages of performance testing. It is hoped that the results achieved will contribute to progress in component reliability.

This paper was first presented at the AIEE-IRE-RTMA Symposium on Progress in Quality Electronic Components, May 5-7, 1952, Washington, D. C.

Sweep Generator

(*Continued from page 54*)

In order to make accurate bandpass measurements, it is necessary to add a frequency marker to the response pattern. This marker is generated by mixing in a germanium diode a fraction of the r-f output voltage of the sweep generator with that of an external marker oscillator. The output of this mixer is a video beat which occurs at the instant when the frequency of the sweep generator is equal to the frequency of the marker oscillator.

The video marker is then amplified sufficiently so that useful frequency markers are produced with marker oscillator input voltage as small as 10 mv. The video marker is then electronically added to the response pattern of the network under test. This marker has constant amplitude regardless of its position on the pattern. The arrangement in Fig. 5 is used when it is necessary to add a frequency marker.

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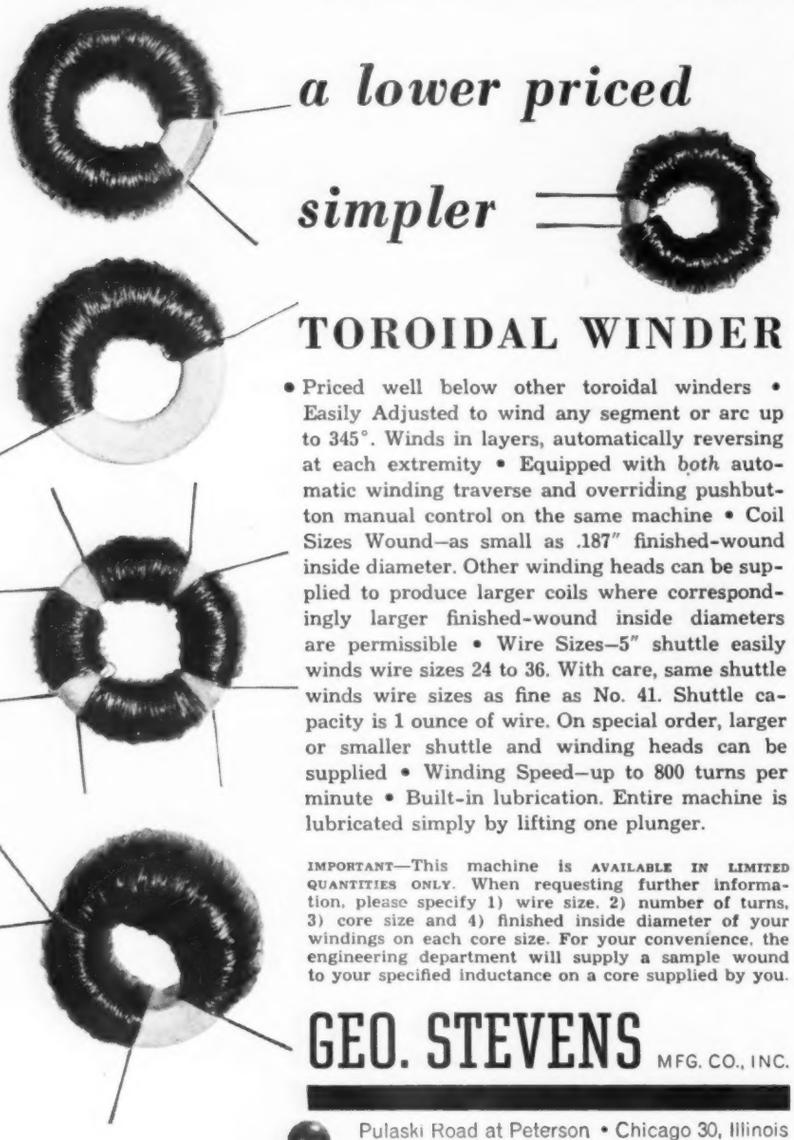

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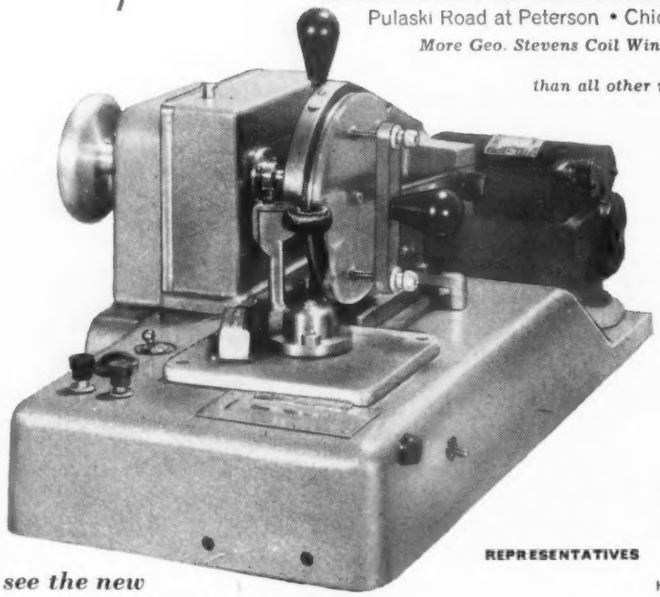

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UHF Tuner

(*Continued from page* 43)

4 in. travel assuring good tracking, stability and maximum travel excursion length per UHF channel. The lines are extremely rugged and stable with wide spacing between, as well as around, the individual lines. The lines are securely supported by means of ceramic standoff insulators. A crystal mixer is directly coupled to the output shorted end of the lines and the antenna is

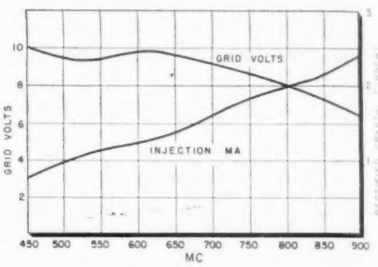


Fig. 7: Injection grid current vs. frequency

mutually coupled to the shorted input end of the lines.

The oscillator tube and associated circuits are completely shielded and adequately meet tentative requirements for oscillator radiation. The local oscillator consists of a type 6AF4 tube capacity coupled to a quarter-wave short-circuited transmission line terminated at the inactive end.

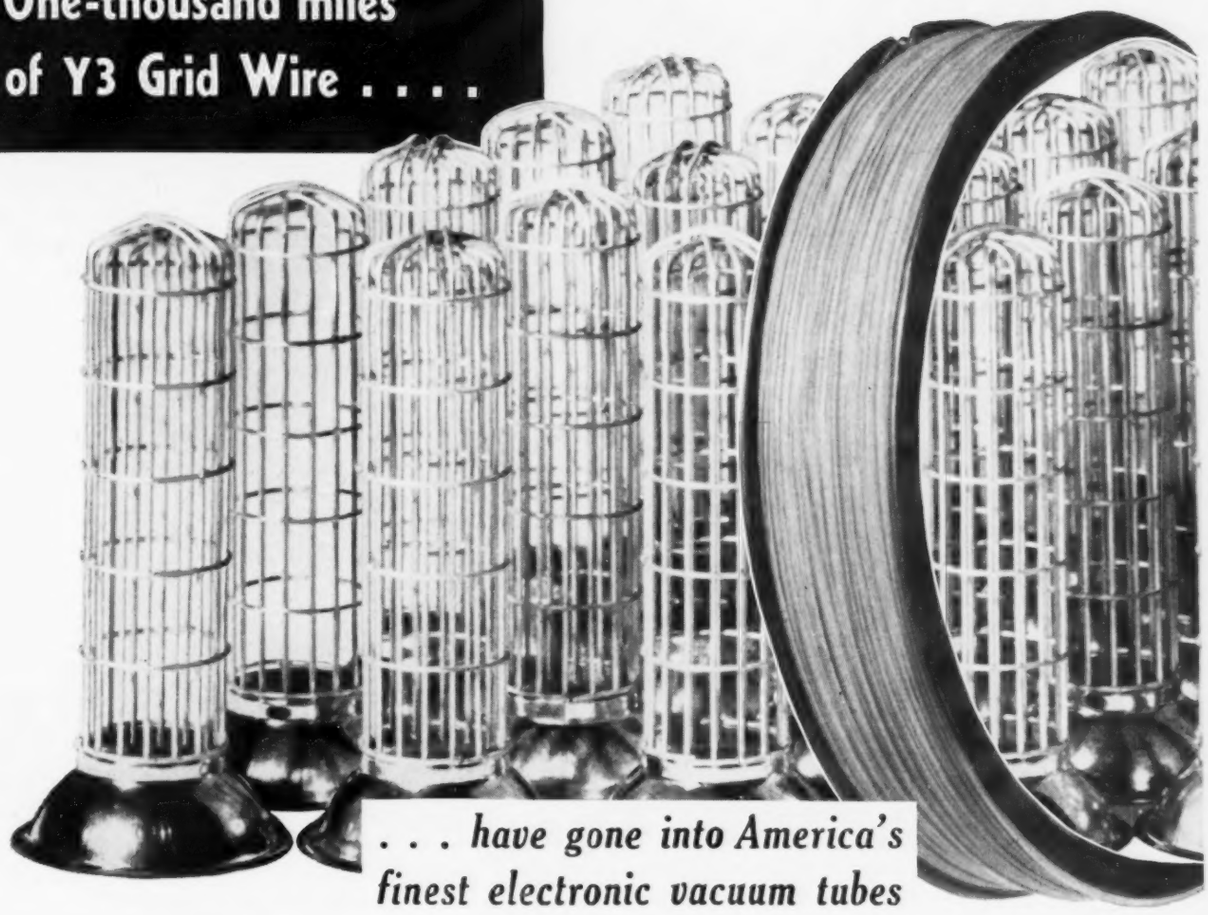
The local oscillator is lower in frequency than the signal in order to prevent inverting the frequency relation between sound and picture carriers for receivers not having symmetrical intercarrier i-f systems.

In order to receive UHF stations between 470 and 890 MC, the local oscillator tunes from 275 to 695 MC when the VHF set is tuned to channel 10. The 6AF4 is used as the oscillator tube on the basis of cost, preferred type, and necessary frequency range. The basic oscillator design has an upper limit of 1100 MC which is much higher than required for UHF tuner application. The oscillator generates adequate injection voltage over the entire frequency range 275 to 695 MC without any frequency skips or undesirable responses rectifying a crystal current of 1 to 3 ma. The injection-grid current curve is shown on Fig. 7.

The B supply is parallel fed through chokes and is satisfactorily bypassed. The oscillator tuning is positively ganged with the preselector line and is accomplished by a

(*Continued on page* 78)

One-thousand miles of Y3 Grid Wire . . . .



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- ***Withstands high temperatures***
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- ***No substantial primary emission***

Outstanding performances by many, many thousands of electronic vacuum tubes utilizing Y3 grid wire have followed years of research by Eimac engineers. Uniquely treated Y3 grid wire suppresses primary emission by nullifying thorium contamination. It maintains rigidity at high temperatures—has a ductility that makes it adaptable for hand or machine winding and is ideal for spot-welding techniques. Eimac's Y3 is superior to molybdenum or tantalum grids operated in similar tubes and conditions. Intended for use with thoriated tungsten filaments, Y3 has long life and no substantial primary emission up to 1300° centigrade brightness temperature. Type Y3 grid wire is produced by Eimac and is available in quantity lots of 100, 500, 1000, 5000 and 10,000 meters.

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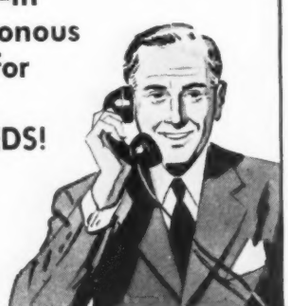
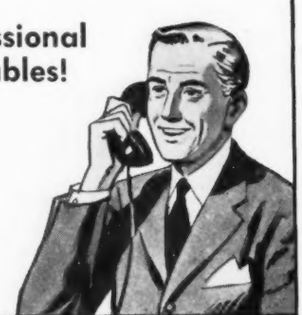
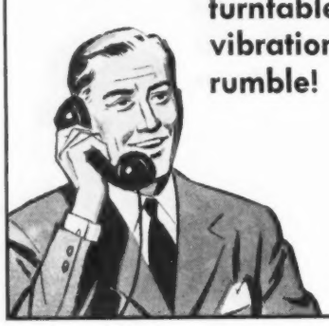
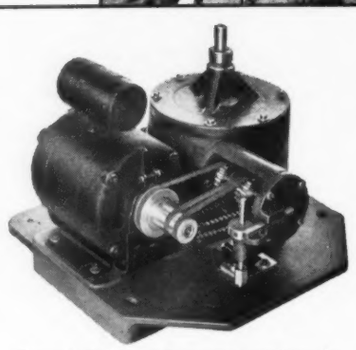


...and costs less than other professional turntables!



Operates quietly...no turntable vibration or rumble!





Geared belts and geared pulleys insure accurate timing for all 3 speeds.

It's a Fairchild exclusive! The new Model 530 Turntable has the *only* synchronous drive integrally designed and built for three speeds. No attachments, no kits are necessary. It reaches *stable speed*—less than ½ revolution at 33⅓ without overshooting. Offers *guaranteed accurate timing* within limits of AC line frequency. Turntable rumble and vibration are practically non-existent.

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sliding silver contact which varies the active portion of the line. A trimmer condenser across the oscillator plate tank circuit allows the frequency range to be set to any desired frequency at the low end of the range.

Due to the ruggedness of construction and quality of components, exceptionally high stability is secured in the local oscillator circuit. The warm-up drift of the local oscillator at the high frequency end of the band is approximately plus 250 KC and approximately minus 250 KC on the low end of the band. The frequency stabilizes after approximately five minutes of operation. The maximum deviation due to line voltage drift is approximately 70 KC throughout the range of 95 to 125 volts line change.

A cascode i-f amplifier circuit is provided due to its inherent low noise. The 6BK7 double triode is used for the i-f amplifier tube due to its cost and favorable noise factor. The i-f amplifier is aligned to VHF channel 10 (195 MC), and is series coupled to the crystal mixer. This amplifies the output of the mixer and allows the converter noise to dominate the noise of the VHF receiver as well as isolate the UHF and VHF oscillators from each other. It also provides additional VHF selectivity against images of the VHF signal and against other signals which would introduce spurious responses; and provides extra attenuations to radiation of the

TABLE I

MC	Noise Factor db	Image Rejection db	Insertion Gain db
500	16.5	42	5.0
600	18.2	31	4.1
700	19.3	24	3.2
800	22.0	14	2.1

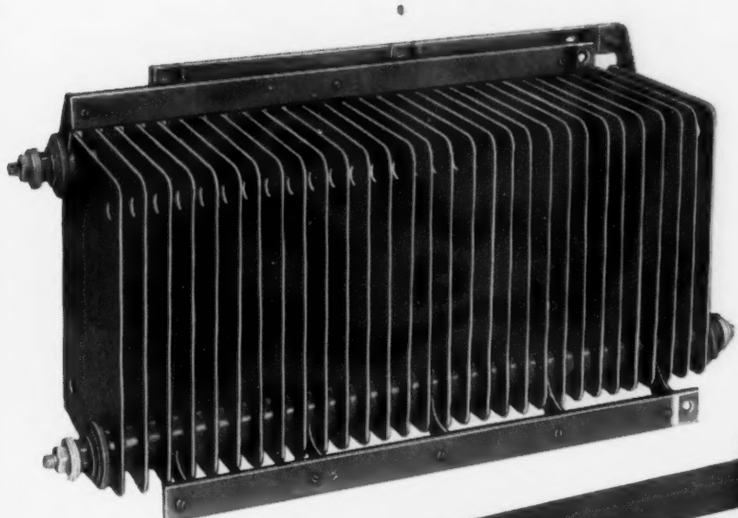
VHF oscillators. The bandwidths of the interstage circuits are very broad and do not require retuning whenever an alternate VHF channel is selected.

Fig. 8 shows i-f response curve at 3 db points and noise bandwidth.

The power gain of the i-f amplifier at 200 MC, measured as the ratio of the power at the 300 ohm output to the power into the grid of the input stage, is 21 db. The bandwidth of the i-f amplifier is adequate to allow mistuning and drift, and to prevent appreciable amplitude distortion. The overall bandwidth is approximately 7 MC and is reduced as much as possible in order to obtain maximum gain as well as provide maximum attenuation to spurious VHF signals. The

(*Continued on page* 80)

Announcing the NEW *Federal* SELENIUM RECTIFIER...with 36 VOLT (RMS) CELLS



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- **Dependable "Federal Performance"**

HERE'S THE ANSWER to your selenium rectifier stack requirements . . . for applications where *space* is at a premium . . . where *weight* is of prime importance. This is the ideal rectifier for many military end-use equipments . . . for aircraft . . . for compact, portable units.

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Wherever you need DC from an AC source—look to Federal . . . *from milliwatts to kilowatts!* For details on Federal's new 36-volt rectifier cells of various sizes—or any other DC power requirement—write to Dept. F-166

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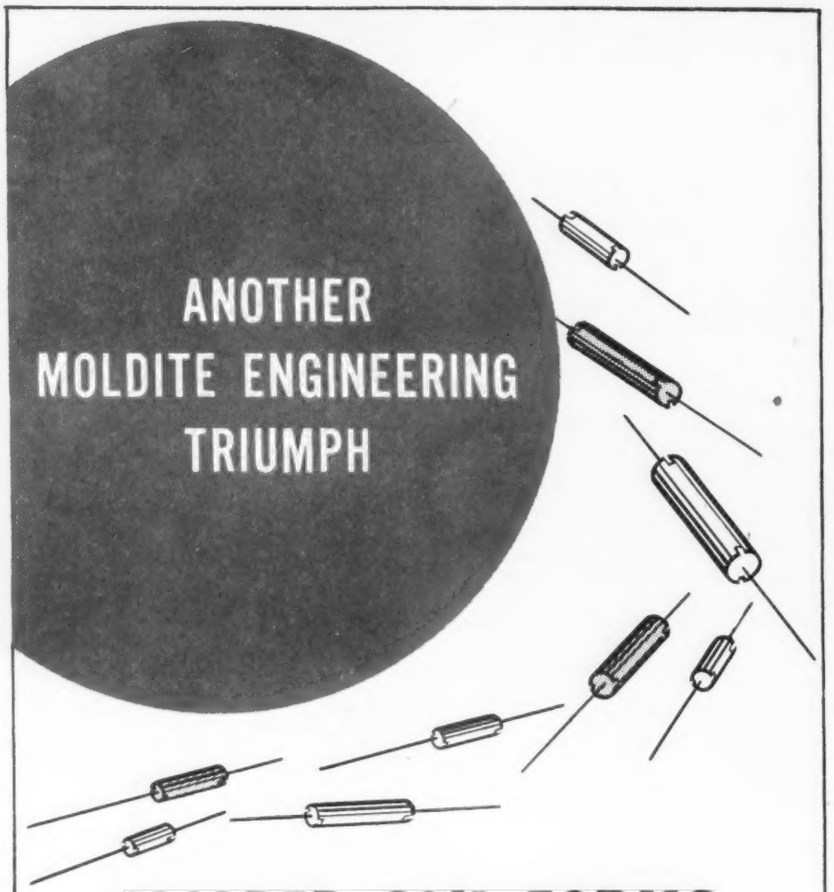

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Here is another example of MOLDITE pioneering in order to provide the radio, television, and communication industries with quality engineered components.

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i-f output transformer can be supplied either balanced or unbalanced and is adjustable from the exterior of the tuner by means of an insulated adjustment shaft for channel selection.

The power requirements for the tuner are: 6.3 volts ac to supply 0.9 amp for filament supply; 117 volts dc to supply 40 ma or 250 volts dc to supply 25 ma for the plate supply.

Table I shows some important tuner performance characteristics.

Microwave Measurements Technique

The basic figure of merit of a UHF tuner can be expressed in the unloaded Q of the preselector lines and is obtained by using two test coupling loops consisting of a single turn loosely coupled to each end of the preselector line close to the shorted end. For this measurement, the antenna transmission line coupling loop and the crystal are removed entirely from the cavity with the dial drive mechanism and slider assembly functioning normally. The trimmer condensers are in place and aligned. The Q of the preselector lines are then computed at various points from the measured bandwidth. It is important that the measured Q's be relatively constant across the band and that the bandwidth obtained at the half-power points be approximately 10-25% of

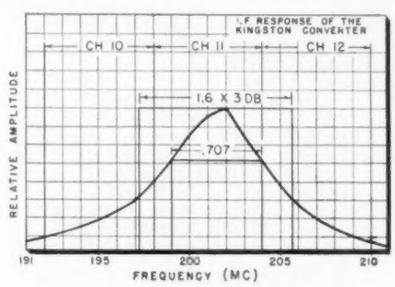
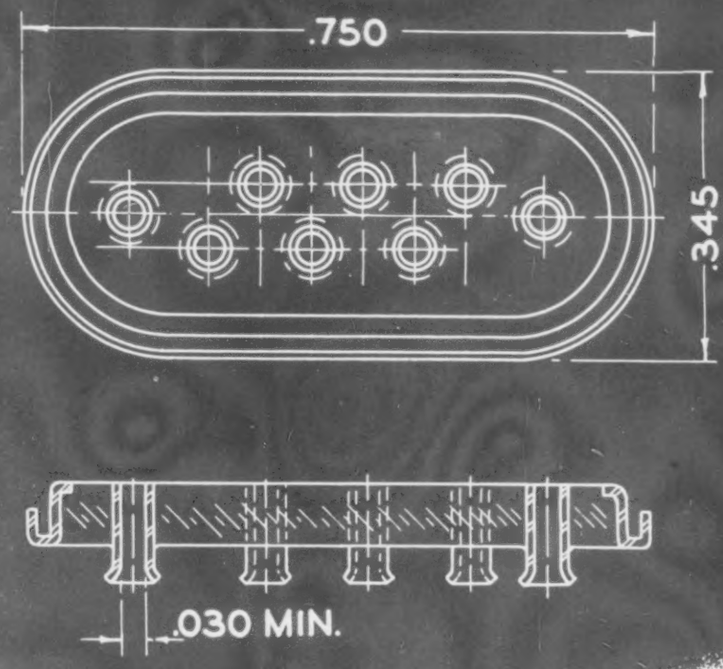


Fig. 8: I-f response of Kingston tuner

the bandwidth desired when fully loaded with the antenna and crystal.

At the various settings of the slider, complete investigation should be made in order to assure that the line or cavity is not responding to an undesired frequency. The unloaded Q should measure approximately 600 for a high quality tuner. The bandwidth is then measured with the antenna coupling and crystal in normal position from the input antenna terminals of the tuner to the mixer section at various frequencies and these bandwidths should not exceed from four to ten times the bandwidth of the unloaded measurements to insure that the insertion loss of the lines will be within an acceptable figure.

SUB
SUB
SUB



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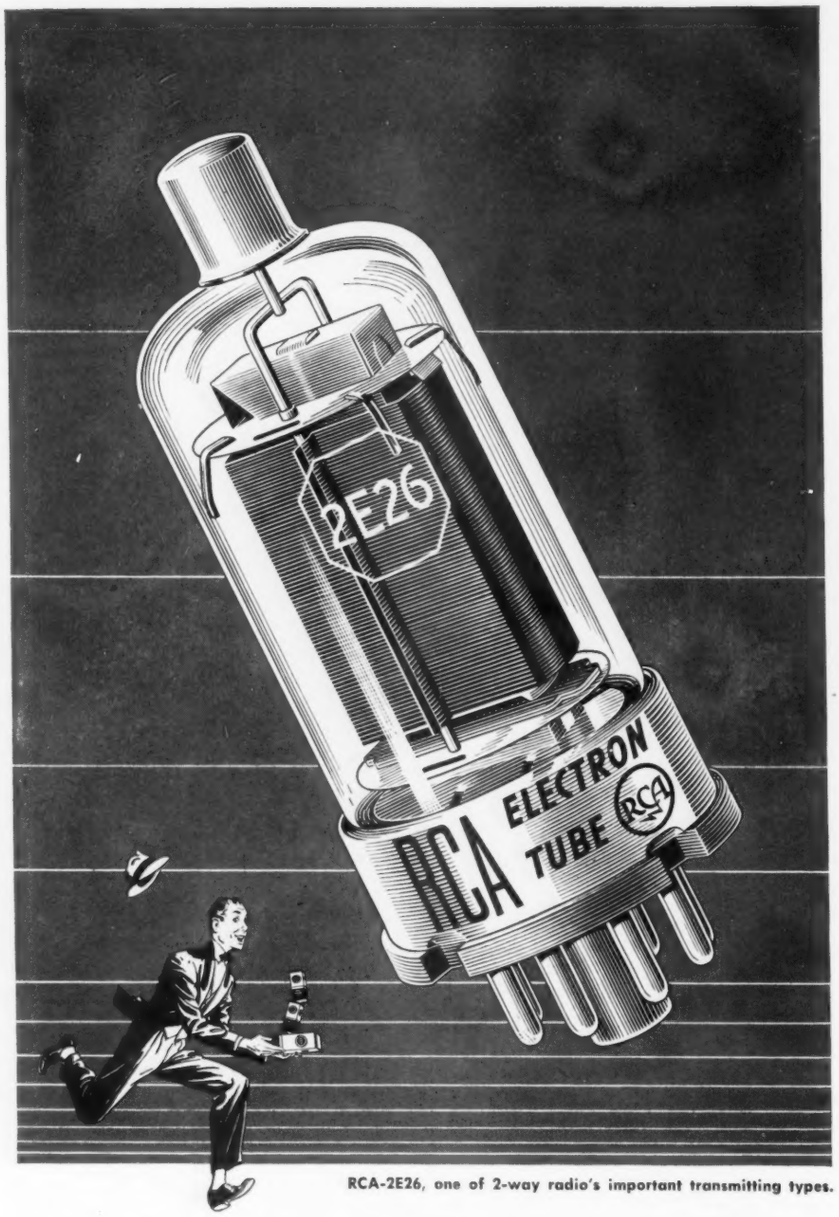

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Mobile Radio

(*Continued from page* 47)

Dan E. Noble, is of the opinion that probably the most significant expansion in the mobile radio field over the next four or five years will take place in the 450-470 MC band. The commercial development of this band has been retarded primarily by the lack of specialized tubes for operating in this frequency region. Excellent tubes are now available, however, for operation in both transmitters and receivers, but at a relatively high cost. The commercial exploitation of the UHF TV bands with resultant mass production of these tubes will bring down the cost considerably.

While there will be normal expansion into the 640 MC band by all of the standard mobile services, the most interesting explorations will probably take place in the so-called "citizens' band," where, on a non-interference-free basis any citizen can use mobile, base station and portable radio equipment to carry on almost any type of communications such as truck dispatch, signaling, teletype and private paging.

Also the growth of these citizens' band radio systems could be one of the most significant contributions to the development of standby communications for Civil Defense. With thousands of such systems in daily use, they could be translated into a Civil Defense network by the simple means of providing central coordination and the necessary discipline when an emergency arises.

Reception in Cities

The 450 MC frequencies seem to be especially suited for radio operation in metropolitan areas and are eventually expected to be used heavily by all who need mobile communications in the densely populated locations. The development of this band may open the way for the FCC to relax its present eligibility rules so that the highway truck and special industrial radio users can reap healthy benefits from 450 MC operation. Its major use now is by several taxicab fleets and other scattered commercial enterprises. Actual tests in urban areas have proved the 450 MC band and equipment to be excellent, with operating coverage and performance equal to or better than the lower FM bands, according to the National Committee for Utilities Radio.

Another recent engineering development expected to open vast new fields in a congested frequency

(*Continued on page* 84)

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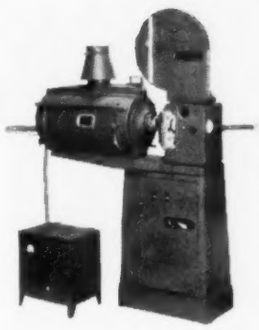

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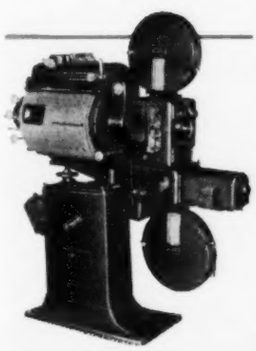

TV Version of Famous Simplex X-L 35 mm Projector: 7,000 Lumens

An incomparable projector used in 80% of all theatres; now equipped for TV use with "2-3" intermittent. 80-110 ampere arc; f/1.9 2" lens.

Here, at last, is background projection made practical for any TV studio or network . . . brilliant, steady motion pictures that make any action scene in 16 mm or 35 mm film libraries available as a setting for TV programs.

No complex phasing needed with TV cameras. Simply focus camera on the background screen for a perfect picture. The GPL "2-3" intermittent pulldown, coupled with a 60 light-pulse per second shutter, automatically meets the camera's requirements. Special optical systems for each projector reduce "throw" required, save studio space.

Get full details on these outstanding projectors, now in use on major networks. Consider them in your new studio planning; add to the utility of your present equipment.

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● Eclipse-Pioneer, one of the world's largest producers of Gyros, has developed a series of direct reading and remote transmitting Gyros for radar stabilization, navigation, remote compass, automatic pilot, and other similar airborne applications.

Typical of these Gyros is the type 14104, a two axis, gravity erected Vertical Gyro Transmitter designed for use as a remote vertical reference where vertical stabilization is required. The instrument is essentially an electrically driven, vertical-seeking gyro with separate Autosyn* transmitter pick-offs on the pitch and bank axes. Sealed in an aluminum case, protection against environmental conditions is accomplished by means of a double "O" ring labyrinth air tight seal. Signals are brought out on sealed headers (terminal panels) and caging and uncaging is obtained thru D.C. solenoids. Provisions are incorporated within the case to reduce bank error encountered in turns. A means of sensing turns is required in order to employ this feature.

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Specifications for Eclipse-Pioneer Gyro Type 14104

Dimensions: 6⅛" diam., 6¾" high • **Weight:** 6¼ lbs.

Operational limits: 360° in roll and pitch with controlled tumbling of the pitch axis at near 90°.

Erection device: A gravity sensitive erection system maintains the gyro in a vertical position to within ±¼° of vertical.

Caging: From any position at full rotor speed in less than 45 seconds.

Power Requirements

Gyro rotor: 115 volts, 400 cycle, 3 phase, 25 VA • **Gyro caging:** 28 volts DC, 5 amperes.

Gyro turn error compensation: 115 volts, 400 cycle, Single phase 40 MA.

Pickoff excitation: 26 volts, 400 cycle, Single phase, 0.34 watts each.

Bank and Pitch Pickoff Information

Input voltage: (Nominal rotor excitation): 26 volts, 400 cycle, Single phase.

Input current: 50 milliamperes.

Input impedance (stator open): 139 + J510 ohms.

Stator resistance—DC (line to line): 34 ohms.

Rotor resistance—DC: 48 ohms.

Stator output—max. (line to line): 11.8 volts.

Sensitivity: 220 millivolts x degree sine of displacement angle.

Null voltage—max.: 70 millivolts.

Phase shift (rotor to stator): 4°

For detailed information, write to Dept. B

ECLIPSE-PIONEER DIVISION of Bendix AVIATION CORPORATION

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spectrum is the conclusive proof that commercial equipment now available in the 25-50 MC band will give satisfactory performance on 20 KC channel widths. This conclusion was reached after numerous and extensive field tests by radio users in the power service, petroleum field, and by leading mobile radio equipment manufacturers. In essence, split channel operation greatly increases the number of mobile radio systems which can be accommodated in the 25-50 MC frequency band by cutting down on the frequency space separating the various systems.

Experimental Work

Experimental work is also being carried on in another portion of the spectrum set aside by the FCC for mobile radio use—the 152-162 MC band—with the split channel operation in mind. While the narrow spacing tests in this band to date have not proved so encouraging as on the lower frequencies, the industry is confident that equipment will eventually be developed which will operate on a much narrower spacing arrangement than that in use at present.

The National Committee for Utilities Radio points to operation on 450 MC as a "new milestone in the advancement of mobile radio engineering." Propagation characteristics of the band are such that metropolitan areas such as New York City, Chicago, Detroit and San Francisco can be ably covered, and the performance of equipment now operating under test conditions and in actual communications systems shows an entire lack of man-made noise and the absence of electrical interference. Operating range of the 450-460 MC equipment is approximately the same as the full range of the 152-162 MC apparatus, with the elevation of the base station transmitter and receiver antenna the chief range determining factor. Its use in rural areas will be rather limited because of the absence of large building walls or other solid objects which produce needed multipath reflection of direct radiation from the transmitters, and the 450 MC network will have irregular coverage in outer perimeters of urban territories where rolling hill country or deep wooded areas are present.

Another trend which will undoubtedly increase the maximum number of mobile radio systems the spectrum can handle is the use of directional antennas.

(*Continued on page* 87)

TINNERMAN

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...FOR THE AIRCRAFT INDUSTRY WITH NEW TINNERMAN ELECTRICAL HARNESS CLAMP!

The new TINNERMAN Electrical Harness Clamp "takes off" on really big-money savings for the Glenn L. Martin Company, builder of the famous Martin Bombers. Aircraft designers and engineers at Martin found that in a quantity such as 1000 planes, a savings of $270,000 could be made... or 18 cents per clamp over former methods for 1500 clamp installations in the new Martin P5M-1 Marlin! Think of this tremendous savings in terms of the thousands of aircraft on order for building America's defenses—and you see how "multi-million-dollar savings" can be made for conversion into even greater production!

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SPEED NUT WAY: Inset shows how T-shaped tongue locks in place. Can't unlatch unless pressure is applied in diagonal direction and tongue is aligned with slot opening. Can be pre-assembled to wire bundle before fastening to structure. Opens and closes by hand, no tools required.
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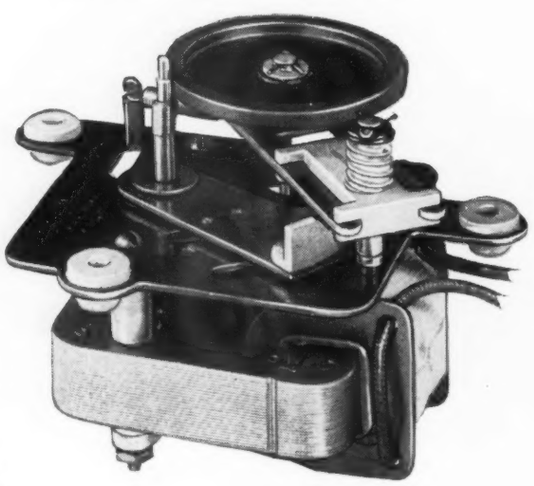

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Computer Solutions

(*Continued from page* 46)

involving control systems, the derivatives will be small and reading errors may accumulate if the indicated integration is performed. A better check is obtained if the equation is differentiated. Then for equation (12) the error e will be

$$e = \frac{(x_{(t+\Delta t)} + \delta_1) - (x_t + \delta_2)}{\Delta t} - A\frac{(y_{(t+\Delta t)} + \delta_3) + (y_t + \delta_4)}{2}$$

Since Δt is chosen small, the recorder errors are predominant. From equation (12), it follows that the error expression reduces to

$$e = \frac{\delta_1 - \delta_2}{\Delta t} - A\frac{\delta_3 + \delta_4}{2} \qquad (13)$$

and the normalizing factor is

$$\eta = \sqrt{2}\sigma\sqrt{1 + A^2/4}. \qquad (14)$$

Next consider the trigonometric equation

$$y = A \sin Bx \qquad (15)$$

where the angle Bx is always less than 90°. Then the error will be

$$e = y + \delta - A \sin B(x + \delta). \qquad (16)$$

By expanding the sine

$$e = y + \delta - A(\sin Bx \cos B\delta + \cos Bx \sin B\delta)$$

Since $Bx < 90°$, $B\delta$ is small and hence

$$e = y + \delta - A \sin Bx - AB\delta \cos Bx.$$

From equation (15)

$$e = \delta - AB\delta \cos Bx$$

and the normalizing factor is

$$9\eta = \sigma\sqrt{1 + A^2B^2 \cos Bx}. \qquad (17)$$

In an analogous manner, it is possible to deal with all types of equations.

This system of checking has been applied to a complex non-linear system consisting of twenty equations. The REAC set-up required all the components of two computers and one servo unit (including the use of several modulator servos for multiplication) and, in addition, several passive networks, diode limiters and cathode followers. The checking time for this problem (including trace reading and using the CPC for the calculations) is 24 man-hours.

A difficulty encountered was the non-linearity of the Brush recorder. It appears necessary to establish a correction curve for the recorder or else to modify the characteristics of the driving amplifier.

Conclusions

Three methods of checking linear systems have been considered. The "zero damping" check is the easiest of the three. However, there are many systems to which it does not apply. The Selected Root Test is the

must complete check because each mode is easily identified and a count of the number of integrators used assures that no extraneous modes are present. This method is easily repeated and no additional REAC components are used. On the other hand, if the number of degrees of freedom becomes large (six or greater), the calculation for initial conditions will become onerous. Furthermore, if passive elements are used it will be necessary to place initial charges on capacitors which may present a switching problem. The Frequency Response Method is easy to use and Nyquist plots are very often available. But this system requires a few additional components which may not be available, and furthermore a judicious choice of the frequencies to be checked must be made to assure that no errors are present.

Dynamic Substitution Method

The Dynamic Substitution Method that has been described results in easier calculations and a large time saving compared to a step-by-step integration for the entire system. If an error has been made, the step-by-step method does not give any clue as to the difficulty. On the other hand, if only one equation in a system is in error, the others will still check by the dynamic substitution method and thus the error is pinpointed. Finally, it should be noted that this method may be improved both from the standpoint of increased error sensitivity and time savings if a device for quantizing REAC voltages is available (i.e., an instrument that will convert analogue voltages to digital form in punched cards at selected time intervals).

Mobile Radio

(*Continued from page* 84)

The recent past and the booming present of the mobile radio industry are conclusive proof of the definite potentialities of the field. Its future is even more promising. Graphically, the growth of mobile radio over the past five or six years is a skyward slanting sweep. One highly respected manufacturing official says that the charted picture of the mobile radio field shows that the industry is in the "fatted calf" below the still-to-come "knee" of the growth curve, and that his company, which presently earns a large percentage of the radio sales dollar, is looking forward to a "very satisfactory" future.

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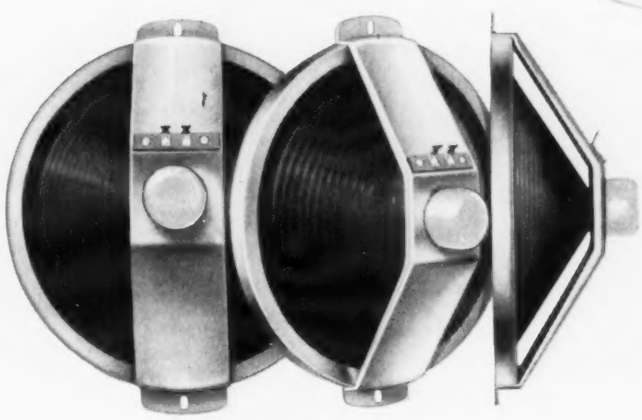

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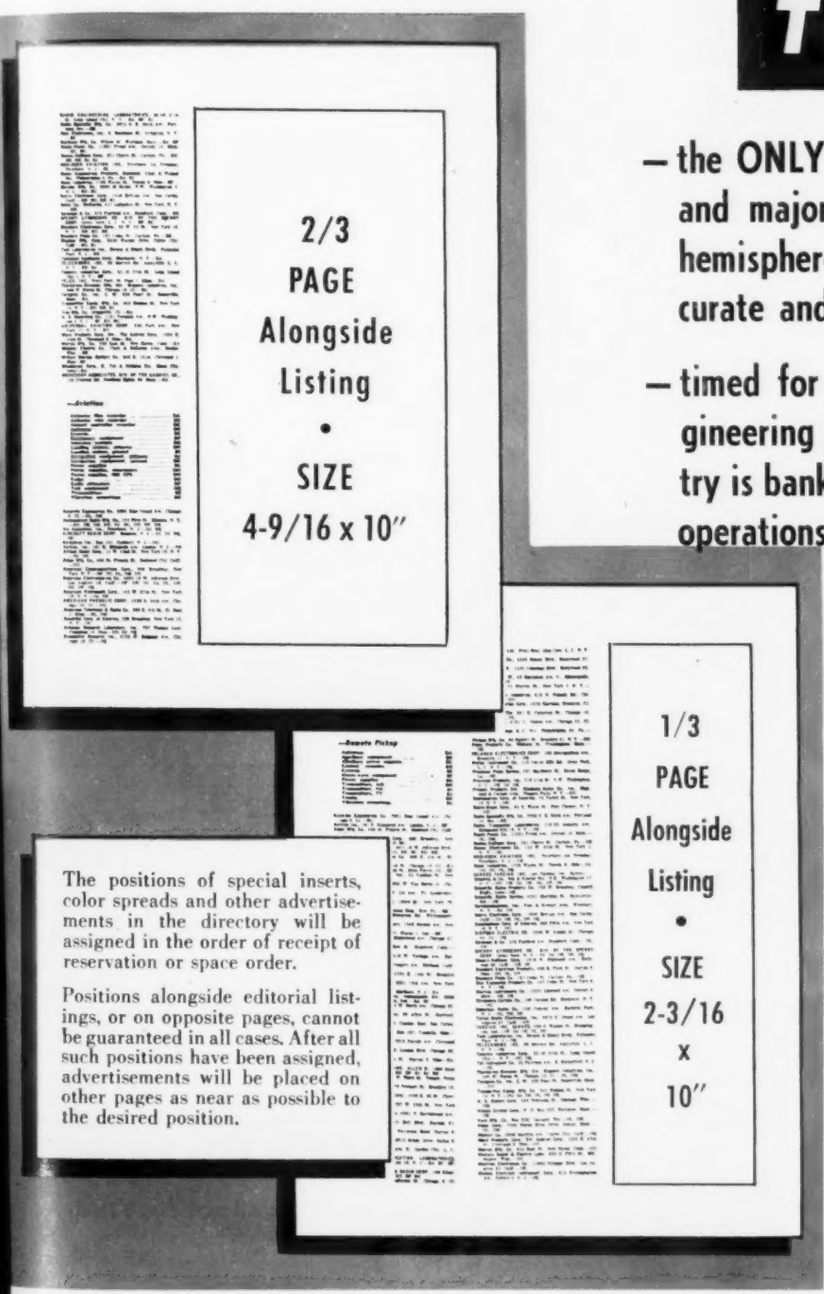
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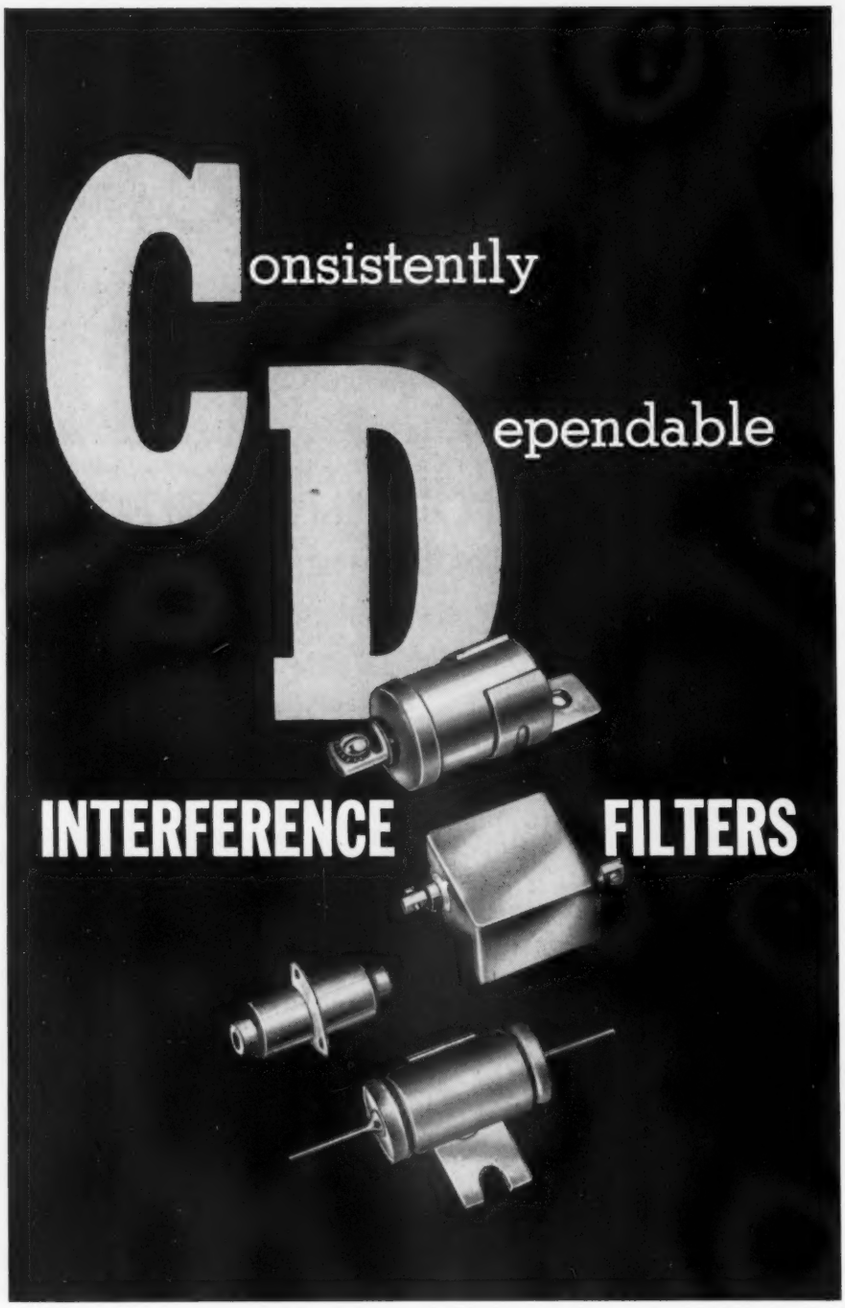

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Amplitude Linearity

(*Continued from page 57*)

brightness quite completely specifies the amplitude transfer of a system. In practice, where several curves are to be compared, it is convenient to normalize the input scales.

Besides the terms gamma and gradient, two other terms have occasionally been employed. They are incremental gain and differential gain. As they both are referred to linear plots of the transfer characteristic, their correlation with the

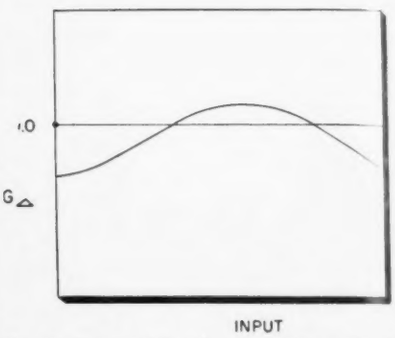

Fig. 7: Incremental gain derived from Fig. 6

sensations of an observer viewing the reproduced picture is poor. However, they are sometimes useful when investigating a single nonlinear device, such as a second detector.

The incremental gain is obtained from the amplitude transfer characteristic as shown by Fig. 6. The incremental gain is defined as the ratio of delta output to delta input, and a plot of incremental gain versus input

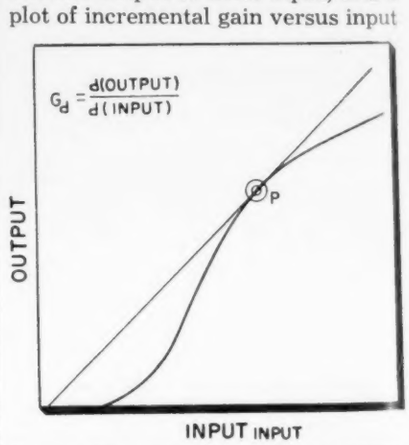

Fig. 8: Differential gain is slope of tangent

for the picture tube of Fig. 6 is given by Fig. 7.

Essentially, this is nothing more than the gain of the device for signals of an amplitude delta input, where delta input is the amplitude measured from zero, for example black level.

The differential gain can be obtained as shown by Fig. 8. The dif-

(*Continued on page 94*)

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DC+	100	25	0.4	3.2	270	8	15	5000
AC−	100	25	0.6	3.2	39	20	21	1 meg.
AC+	100	25	0.6	3.2	39	20	18	1 meg.

All data taken with Screen voltage of 150 and Plate load of 4000 ohms with typical on-the-air television signals and average production tubes.

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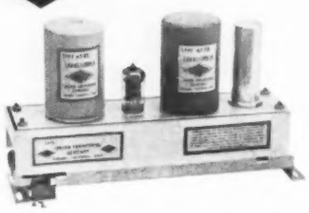
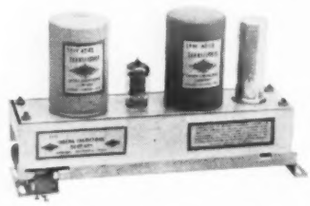
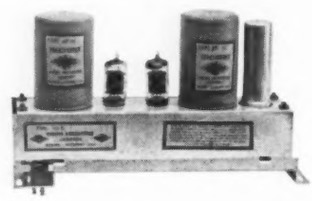


101-AX. A laboratory pre-amplifier. Uses single 12AX7 tube with triode sections in cascade. 42 and 32 db fixed gain. 80 db signal to noise ratio at maximum output. Intermodulation 2% at plus 4 dbm (using 12 kc and 40 cps at ratio of 1 to 4). Multi-impedance input and output. Feedback loop purposely does not include input and output transformers, thus allowing for complete line isolation and maximum flexibility. Complete details in Catalogue 16-C.



101-BX. A boom microphone pre-amplifier especially designed for low level dialogue pickup. For use in six to ten-foot pickups as in motion pictures and TV. Feature of design is 10 db more gain above hum and noise level than conventional pre-amplifiers. 50 and 40 db fixed gain. Intermodulation 2% at plus 4 dbm (using 12 kc and 40 cps at a ratio of 1 to 4). Feedback loop purposely does not include input and output transformers, thus allowing for complete line isolation and maximum flexibility. Complete details in Catalogue 16-C and Bulletin C-1016.



102-AX. A laboratory line amplifier. 42 db gain. 95 db signal to noise ratio at maximum output. Maximum input minus 18 dbm. Maximum output plus 24 dbm. Multi-impedance input and output. Intermodulation 2% at plus 24 dbm (using 12 kc and 40 cps at 1 to 4 ratio). Feedback loop purposely does not include input and output transformers, thus allowing for complete line isolation and maximum flexibility. Complete details in Catalogue 16-C.

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CUES for BROADCASTERS

(*Continued from page 51*)

this time the "stub" was ungrounded during night operation. Grounds were, of course, necessary during the day when the erection crew was working.

Above the 100 ft. mark we found it necessary to tune out the stub base capacity by means of a variable inductance between stub base and ground. This comprised a parallel resonant circuit and offered very high opposition to the flow of r-f currents to ground. To facilitate tuning of the variable inductance a sampling loop was set up about 100 ft. high on one corner of the stub and connected by means of a short run of RG8/U cable to a germanium rectifier and microammeter just above the insulator on that leg of the tower. Then the inductance was adjusted for minimum reading on the microammeter.

These steps enabled us to "stay legal" at the monitoring points without further trouble until a 225 ft. elevation was reached. At this point we ran into serious trouble. No temporary expedient seemed to produce appreciable results and variation of phase and/or currents in the array would not suffice. Our only answer was a slight reduction in transmitter power to the point where the null points were again within the legal limits. We received from the FCC blanket permission, while under construction, to vary phasing and current ratios in our array as necessary to maintain protection to other stations on our operating frequency. The addition of more steel each day and the increase of stub height necessitated a further reduction in transmitter power output until we were down to 25 kw. This was the lowest level at which our transmitter was designed to be operated and we had completed only half of the new tower.

The problem was solved by connecting a copper wire to the stub at about 225 ft. and running it down inside the tower, tying it off with small glass insulators at about 50 ft. intervals and grounding it. The tower capacitance was still balanced out by inductance. The monitoring points returned to comfortable values, power was run back up to 50 kw, and tower erection proceeded to completion. There was only one further case of pattern disruption and that was cured by clearing an accidental short circuit of the wire to the tower leg about 40 ft. below the point where it was connected.

We did not have time to run complete pattern measurements on this arrangement, but assumed that, since the two monitoring points were correct, the rest of the pattern was approximately correct.

WTVJ Builds Camera Chain

A new film camera chain has been constructed by WTVJ, Miami, Fla. The equipment was designed to be used with the new Eastman Kodak Model 250 TV Film Projector. Complete accessibility is the camera's most distinctive design feature. The unit has three full doors and a removable top. Other advantages are: Pedestal is storage space for spare tubes and amplifiers, and conceals unsightly camera cable. The camera can be operated at any distance up to 200 ft. from the control console. Simplified camera design made possible by piping deflection signals from equipment room to camera through standard camera cable. Reduced heat in camera insures stable operation. Maintenance men work in equipment room racks rather than under the feet of control room engineers or projectionist. Full fades to black are reproduced automatically by RCA "white-pulse" clamp circuit. High signal-to-noise ratio is accomplished by new video amplifier design. Remote relay controls picture polarity. Remote relay control of frequency response enhances 16mm film resolution.

Norman Dean demonstrates his new film camera chain which he designed for WTVJ

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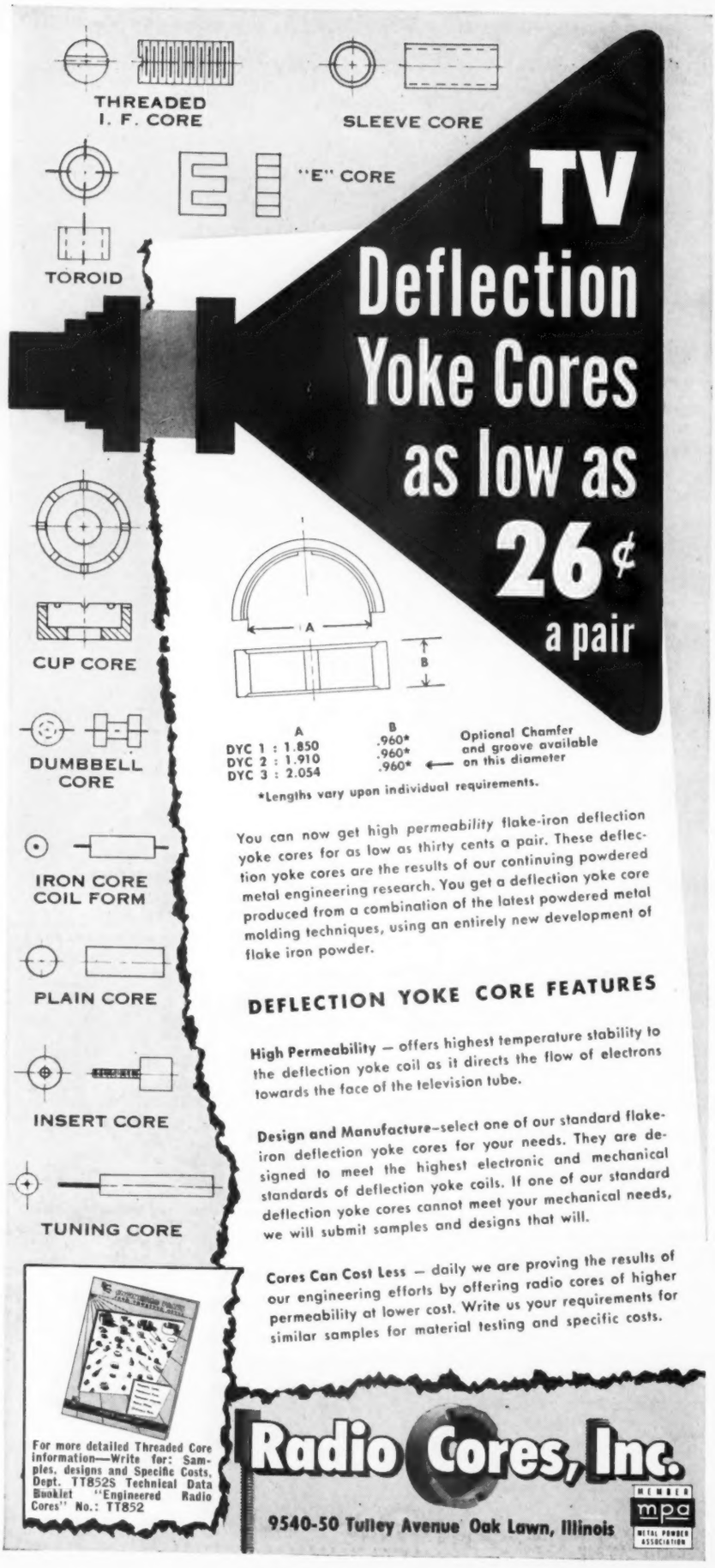
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ferential gain is defined as the slope of the tangent line to the curve at some point P, i.e.:

$$G_d = \frac{d\ (\text{Output})}{d\ (\text{Input})} \qquad (5)$$

A plot of the differential gain of the device described by Fig. 8 is given in Fig. 9. This plot is particularly useful when we wish to obtain the gain of the device for small signals which vary around a particular value of input. Again it should be stated that these plots are only of occasional use as the log plots offer a high correlation with the viewed picture.

The actual measurement of the non-linear devise can be usually made with conventional techniques as the measured quantities are volts or amperes. When it is necessary to measure brightness values the problem is somewhat more difficult, although there are several excellent methods available which involve the use of the MacBeth Illuminometer. The usual problem presented by non-linear devices is not their physical measurement, but expression and interpretation of measurement.

Because of the misinterpretations and lack of rigorous application associated with the term "gamma," it is suggested that the expression gradient be used to describe the amplitude transfer characteristics of TV systems. When used with normalized scales to represent overall brightness characteristics, a concise and practical expression for system tone rendition is obtained.

Fundamentally, a non-linear device is not a simple thing. If use is made of incremental and differential gain when only output voltage as a

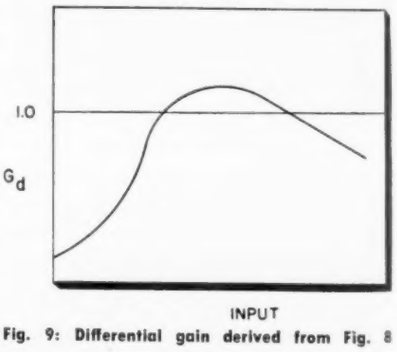

Fig. 9: Differential gain derived from Fig. 8

function of input voltage is desired, the amplitude transfer of non-linear circuits can be described. Likewise, if gradient is used to describe the brightness transfer of a system, the tone rendition of the system, even though the system may be intentionally non-linear, can be accurately described.

1. B. M. Oliver—"Tone Rendition in Television," **Proc. IRE**, vol. 38 no. 11, Nov. '50, pp 1288-1305.

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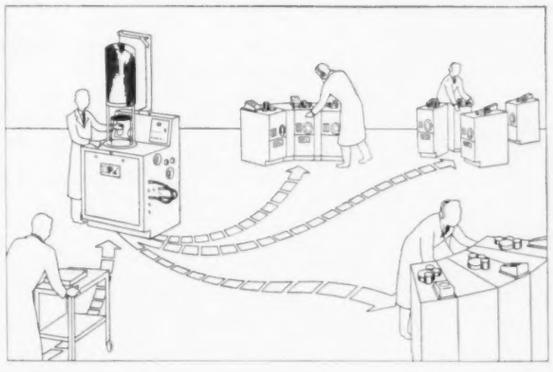

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STANDARD TRANSFORMER CORPORATION

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Fuse Protection

(*Continued from page* 41)

pass their tests up to 20 amps, 250 v. and the Navy is currently testing 30 amp fuses at 125 v., 25,000 amps. It should be pointed out that better than ordinary clips and holders are required above 20 amperes to avoid exceeding the 70°C maximum temperature rise at the fuse caps.

In general, medium lag fuses are used for power supplies, primary and secondary; battery chargers; and tube plate circuit protection.

High voltage fuses in ratings 1,000, 5,000 and 10,000 v. and currents to 5 amps also are available, most all in medium lag characteristics. Most of these fuses are used for high-voltage power supplies and generators.

Delayed action Fuses: These fuses are used in inductive, capacitive and tungsten lamp circuits having high starting currents as compared to the normal, steady state load. Illustrative are motors, solenoids, magnets and filter circuits. Other applications are those where the blowing point must be near the normal current load and also intermittent transient loads such as vibrators which are likely to cause cyclic failure in simple element fuses. As a general rule, time-delay fuses use a dual element, one part consisting of a fusion point or junction which opens on low sustained overloads and which is in series with a fuse link blowing at four to five times the fuse rating under short-circuit conditions.

There are many opinions available regarding the percent of rating that fuses can be loaded without failure. U. L. specifications call for fuses to carry 110% rating indefinitely. In actual practice, the 110% test is considered satisfactory at the end of four hours minimum. Furthermore, in order to blow at the required 135% in one hour, fuse ele-

(*Continued on page* 98)

Fig. 6: Fuse mountings used in electronic field

Designed for dependability

...tested (and re-tested) for precision

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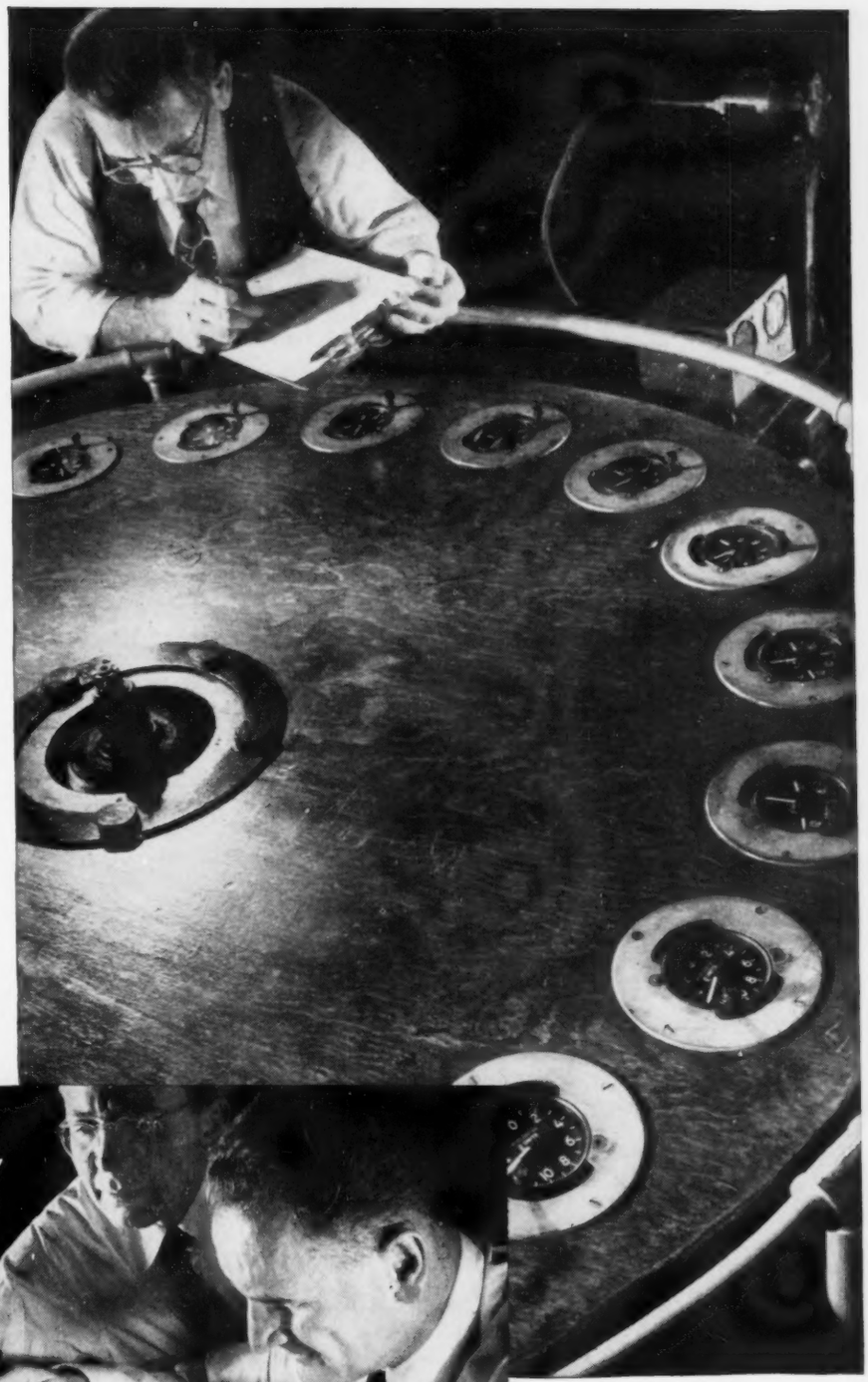

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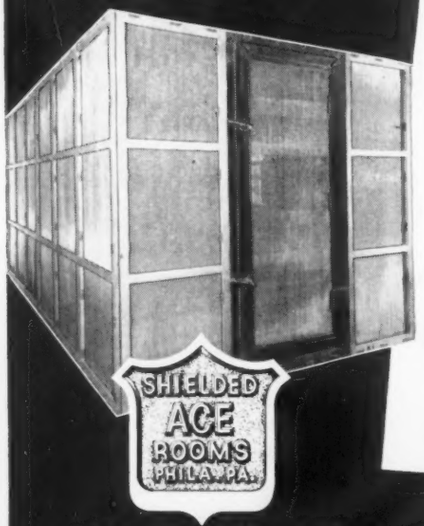
SUBSIDIARY OF *Standard* COIL PRODUCTS CO. INC.

MEET

JAN-I-225, 16E4 (Ships) and MIL-I-6181 Specifications for Radio Interference Suppression!

ACE *Pre-built* SCREEN ROOMS



Features

1. Attenuation of 100 DB and higher from 0.15 to 10,000 MC.
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3. Standard and special types and sizes to meet practically any requirement.
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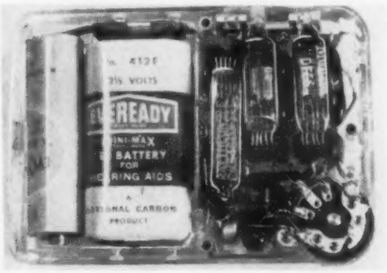
ments are running fairly hot even at 100% rating. Again, "indefinitely" is a long time; a more finite expression would seem desirable. Our experience indicates that while many fuses will carry 100% rating for very long periods, it would be safer engineering practice to consider the life of fuses in somewhat the same category as tungsten lamps at this loading, or, 1,000 to 3,000 hours. The best rule of all is always to use the largest fuse possible consistent with safety; thus, for short circuit protection, load fuses to only 25% or 50% of rating and in all cases keep within 75% of rating if possible. This gives a comfortable margin against cyclic fatigue and harmless overloads.

A brief description of fuse holders developed for the electronic industry will be of interest. The trend has been toward the extracting and shockproof type of holder as contrasted to the open, but less expensive, mountings formerly used. See Fig. 6. Of particular interest is the miniature post for 3AG fuses, with waterproof and indicating holders for the military services.

The trends are toward smaller fuses and fuse holders, which will come as the need arises. From the standpoint of size and low cost, it would seem that fuse protection still represents the best value for the money in this element of circuit design.

Miniaturized Amplifier

Shown below is an interior view of a miniaturized three stage amplifier in the Wendton, German hearing aid being introduced into the U.S. by Evecar Inc., 11 W. 42 St., New York City. This unit which contains microphone, batteries



and amplifier weighs 2.8 oz and measures only 3.4 x 2.4 x 0.9 in. Design provides for use of standard types of American subminiature tubes and batteries. The B battery permits 150-200 hours of service while the 1.5 v A battery will provide about 8 hours of service. A printed amplifier circuit is employed, and the plastic case is available in all colors. Costs of the hearing aid, including import duties, is said to be considerably less than those of American manufacture.

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plastic or braided type, conforming to Government Specification JAN-C-76, etc., for radio and instruments. Solid or flexible conductors, in a variety of sizes and colors.

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Underwriters Approved, for 80° C., 90° C. and 105° C. temperature requirements. Plastic insulated, with or without braids.

SHIELDED JACKETED MICROPHONE CABLE
Conductors: Multiple—2 to 7 or more conductors of stranded tinned copper. Insulation: extruded color-coded plastic. Closely braided tinned copper shield. Tough, durable jacket overall.

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for VHF and UHF, AM, FM and TV high frequency circuits. LENZ Low-Loss RF wire, solid or stranded tinned copper conductors, braided, with color-coded insulation, waxed impregnation.

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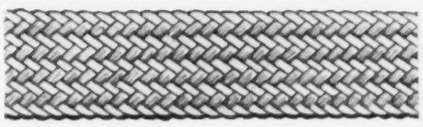
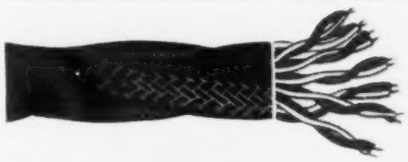
Conductors: Extra-flexible tinned copper. Polythene insulation. Shield: #36 tinned copper, closely braided, with tough durable jacket overall. Capacity per foot: 29MMF.

SHIELDED MULTIPLE CONDUCTOR CABLES
Conductors: Multiple—2 to 7 or more of flexible tinned copper. Insulation: extruded color-coded plastic. Closely braided tinned copper shield. For: Auto radio, indoor PA systems and sound recording equipment.



TINNED COPPER SHIELDING AND BONDING BRAIDS
Construction: #34 tinned copper braid, flattened to various widths. Bonding Braids conforming to Federal Spec. QQ-B-575 or Air Force Spec. 94-40229.

SHIELDED COTTON BRAIDED CABLES
Conductors: Multiple—2 to 7 or more of flexible tinned copper. Insulation: extruded color-coded plastic. Cable concentrically formed. Closely braided tinned copper shield plus brown overall cotton braid.



PA AND INTERCOMMUNICATION CABLE
Conductors: #22 stranded tinned copper. Insulation: textile or plastic insulated conductors. Cable formed of Twisted Pairs, color-coded. Cotton braid or plastic jacket overall. Furnished in 2, 5, 7, 13 and 25 paired, or to specific requirements.

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offers lowest priced Ion Trap
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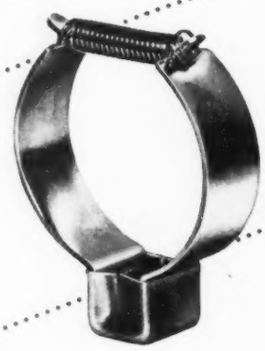

MODEL T-312. The new simplified steel construction lowers manufacturing costs by fully utilizing, for the first time, the Alnico permanent magnet's maximum efficiency. This makes Model T-312 the lowest priced ion trap on the market. Installs in only 2-3 seconds—just slip on.

FEATURES OF BOTH MODELS

STAYS PUT—No wobble; no shift during shipment; no realignment necessary when your TV set is installed in the home.

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STABILIZED AND TESTED on special equipment designed and used only by Heppner, each individual Heppner Ion Trap is guaranteed to meet your working requirements.

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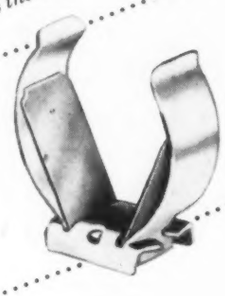
LIGHTWEIGHT—Snap-On Model weighs only ½ ounce; Slip-On Model only 3/5 ounce. Will not harm tube's neck.

ALNICO P.M. USED—Retains magnetism indefinitely.

SNAP-ON ION TRAP

installs instantly—just snap on—stays put



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Magnetic Powder Cores

(*Continued from page* 38)

however, in the volume resistance of the materials, which in several cases dropped by a factor of one to ten million. The volume resistance values are tabulated in Table I for the as received condition and after the heat treatment. It is interesting to note that the IRN 8 shows relatively the least change, which agrees nicely with the observed stability of the Q values.

The absolute values of the volume resistivity in the as received condition will be discussed later.

Effects of the Moisture Resistance Test

In order to test the stability of the powdered iron core materials against changes in relative humidity and temperature, a series of 18 slugs and 22 toroids was subjected to the standard moisture resistance test according to MIL-T-27, consisting of 10 cycles of changing humidity and temperature above ambient, and five freezing subcycles.

Upon completion of the tenth cycle, the samples were dried for 24 hours and retested. Two of the 18 slugs which had been slightly oversize to begin with, could not be retested because they swelled to such an extent that they did not fit the test coil any more. Of the remaining 16 slugs, 10 showed Q changes of less than 2%, which is probably within the accuracy of the Q meter. In five slugs, the Q increased between 2 and 10%, while in the one remaining slug it had decreased by 14%. Except for this one sample the permanent Q changes caused by the moisture resistance test would seem acceptable. It should be noted, however, that this result does not contain any information on the core performance while exposed to moisture and elevated temperature.

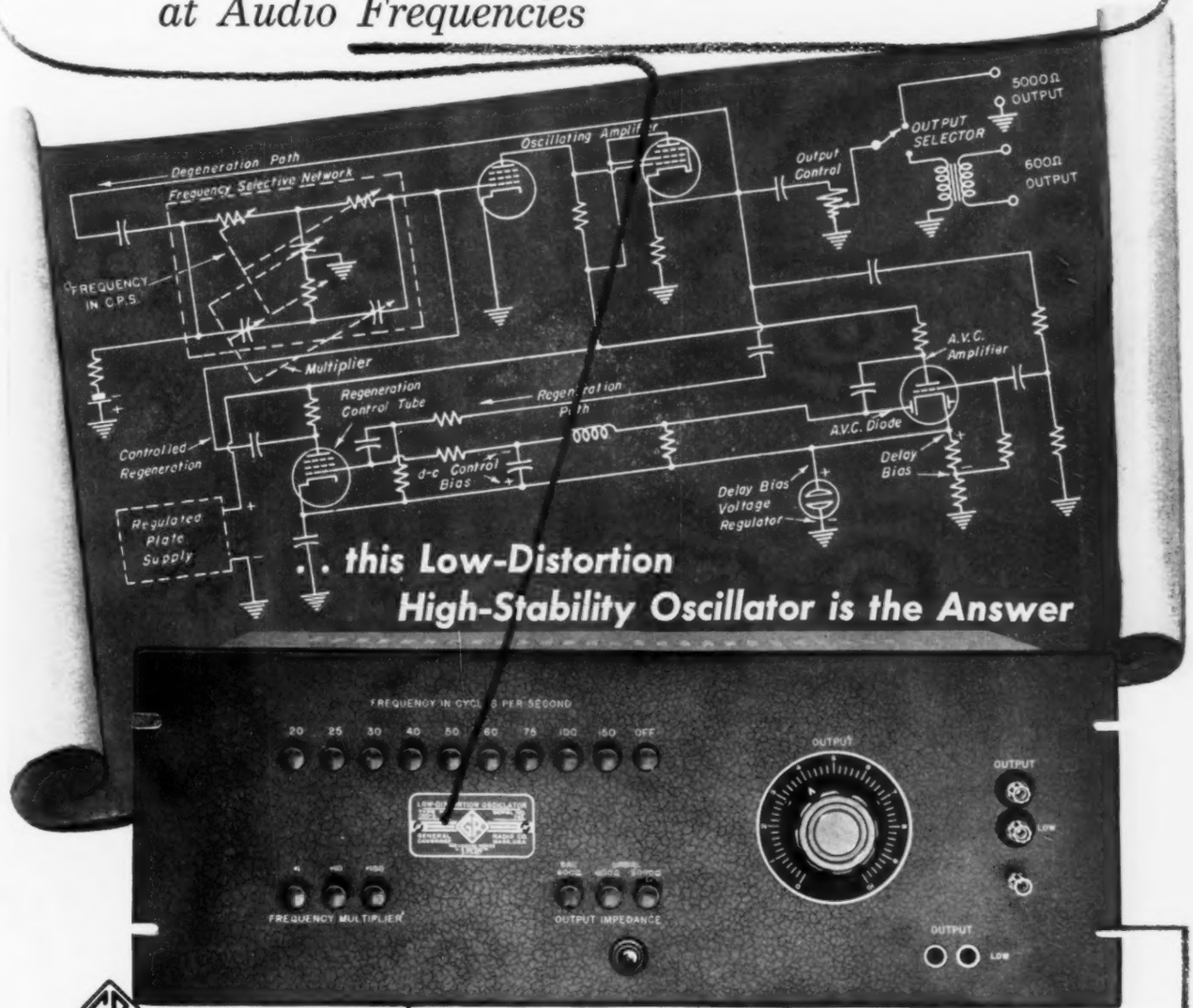
The moisture resistance cycling had two objectionable side effects, namely swelling and corrosion. All slugs showed a permanent increase in diameter ranging from about 0.1 to 0.7%. Only seven of the 18 slugs tested did not show any visible corrosion, while five were lightly, two moderately and four heavily corroded. Swelling, especially when accompanied by corrosion, may easily lead to binding and destruction of tuning slugs in tightly fitting coil forms.

The moisture resistance test had, in 13 of the 18 slugs, a highly beneficial effect upon the volume resistivity. Table II compares again the values in the as received condition, but this time with the values after

(*Continued on page* 102)

for DISTORTION and BRIDGE MEASUREMENTS

at Audio Frequencies



. . this Low-Distortion High-Stability Oscillator is the Answer

The GR Type 1301-A Low-Distortion Oscillator provides an exceptionally pure waveform . . . less than 0.1% distortion between 40 and 7,500 cycles, and not more than 0.15% at all other frequencies.

For distortion measurements and audio facility checks at broadcast stations or in the laboratory, for production checking of high-fidelity audio equipment, and where distortion measurements must be made rapidly and yet with confidence in the results, this instrument has proven most useful.

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Very Low Distortion — *frequency selective network provides complete degeneration of all frequencies above and below frequency adjusted to*

5,000-ohm output — distortion less than 0.1% from 40 to 7,500 cycles; 0.15% at 7,500 cycles to 15 kc and same with Extension Unit from 2 to 40 cycles

600-ohm output — distortion less than 0.1% from 40 to 7,500 cycles; 0.25% from 20 to 40 cycles and 0.15% above 7,500 cycles

Rapid Coverage of Audio Range — *27 fixed frequencies between 20 and 15,000 cycles selected by push buttons. Any desired frequency between steps obtained by plugging in external resistors. Type 1301-P1 Range Extension Unit covers range from 2 to 15 cycles*

High Stability — *internal voltage regulator eliminates frequency drift due to variations in plate supply. Changes in load have no effect upon frequency. Frequency drift not greater than 0.02% per hour after the first ten minutes operation*

Constant Output — *AVC diode controls regenerative tube bias, holding output constant to within 1 db over the entire range. Three Outputs: 5000 ohms unbalanced, 600 ohms balanced and unbalanced. Outputs: 18 mw into 600 ohm and 100 mw into 5,000 ohm loads*

Accurate Frequency Calibration — *adjusted to within ± (1½% + 0.1 cycle)*

No Temperature or Humidity Effects — *operation is substantially independent of climatic changes normally encountered*

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RAYPAR also manufactures all sorts of I. F. and R. F. windings, such as antenna coils, oscillator coils, R. F. chokes, flyback transformers, width coils, linearity coils, video peaking coils, filter assemblies, and special purpose R. F. coils of any type or construction.

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the moisture resistance test. In the as received condition, the product of manufacturer A exhibits the highest volume resistivity values for all but the IRN 8 material. Two of his materials, namely Carbonyl E and TH remain unchanged in the test, two others, Carbonyl C and SF decrease, and IRN 8 increases in volume resistivity. Manufacturer B's materials have a lower initial volume resistivity in the carbonyl grades, all of which are improved by the test, while the IRN 8 was initially high and decreases upon the treatment. The materials of manufacturer C all increase in the moisture resistance treatment.

Although the evidence is not yet entirely conclusive, it seems that the differences in the reaction of the various materials can be correlated to corrosion on one hand and to a detrimental effect of moisture on the binder on the other. Corrosion led in all cases to an improvement of the volume resistivity. This is probably due to the presence of a partially exposed highly conductive surface film in the original material which is converted into a corrosion product of higher insulation resistance during the test. No corrosion was observed in the three cases in which the volume resistivity went down and in the two cases where it remained constant. The latter behavior is, of course, the most desirable, and it is somewhat disturbing to note that only two out of 18 samples were not affected by the moisture resistance test in this respect.

The permeability tests on the toroid series subjected to the same

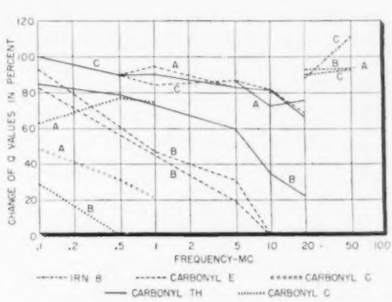

Fig. 6: Q value change caused by 300°C heat

treatment did not reveal any permanent damage in the materials represented. It should be reported, however, that the permeability of several samples fell far short of the values claimed by the manufacturer. Discrepancies of 30% were observed in at least three cases, all of which were materials with a nominal permeability in excess of 30. This observation is all the more puzzling as

(*Continued on page* 104)

"Boy! What a signal we have!"

That's how George D. Robinson. Manager of WSUN, St. Petersburg, Florida, expressed his satisfaction with the performance of two new Blaw-Knox Antenna Towers that help extend the coverage of WSUN's transmitting facilities. These AM and FM* towers, *grounded in salt water* are subject to high winds and unusually corrosive atmospheric conditions. Consequently the extra sturdy construction of Blaw-Knox Types H40 and CH, plus the protection of hot dip galvanizing were prime factors in determining their selection for this site... If you are planning telecasting facilities we would be pleased to discuss your tower requirements at an early date.

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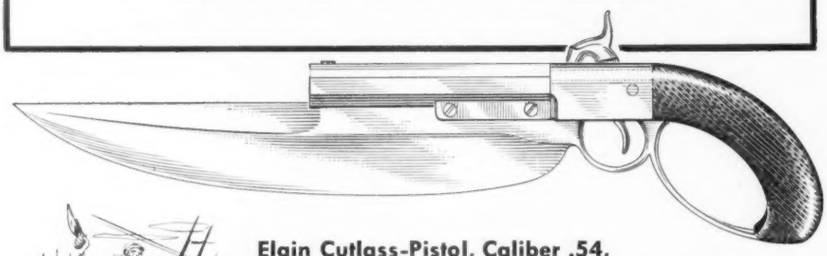
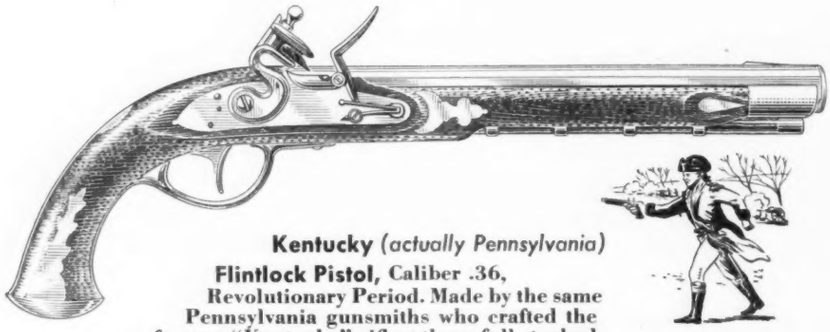
**Tower at left is designed to accommodate TV antenna when authorized.*

BLAW-KNOX ANTENNA TOWERS

Famous Guns



Elgin Cutlass-Pistol, Caliber .54,
1837 Model, made by C. B. Allen. Invented by George Elgin of New York, this formidable arm was intended to take the place of the cutlass and pistol commonly used by naval boarding parties. One of several variations of this weapon is the shorter Bowie-Knife Pistol.



Kentucky *(actually Pennsylvania)*
Flintlock Pistol, Caliber .36,
Revolutionary Period. Made by the same Pennsylvania gunsmiths who crafted the famous "Kentucky" rifles, these full-stocked pistols actually were rifles-in-miniature. Every "Kentucky" pistol is unique; the same gunsmith never made two alike.

Instant-heating
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for light or heavy work. Dual heat greatly increases tip life. Switch instantly to high or low heat as job requires. Pre-focused spotlights end "blind soldering". Exclusive tip-fastening arrangement assures full, constant heat. Shatter-proof plastic housing. Perfect balance. Low-cost, replaceable tips. Pays for itself in a few months. See at your Distributor or write for Bulletin direct.

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the cores were standards and certified by two manufacturers as representative of their product.

Acceptable Core Materials

The tests just described, although they were limited in scope and possibly open to criticism on several points, appear to warrant two conclusions:

1. There are powder core materials which cannot be expected to perform properly under stressed environmental conditions and which therefore should not be used in military equipment.

2. There are indications that the stability of core materials at elevated temperatures and under high humidity is determined by the manufacturing process rather than by the grade of iron powder used.

The implications of this situation must be disturbing to everyone concerned with military communication equipment, i.e., the core manufacturers, the radio industry and the responsible government agencies. Appropriate remedial action should be taken immediately. Obviously, the first step must be to secure and disseminate the information on core stability under stressed environmental conditions which has been lacking so badly. The core manufacturers ought to be quick in realizing how important such information is to their customers and how much they can benefit themselves by providing this service. They should recognize that it is nothing but their normal responsibility to supply their customers with whatever engineering data may be needed for the successful application of the materials they buy.

In order to assure the greatest benefit to all concerned, the gathering and dissemination of these data should be a cooperative effort of the manufacturers, preferably coordinated through the Electronic Core Standards Subcommittee of the MPA. It would be the job of this committee to set up, in close liaison with similar organs of the RTMA and IRE, standard test objectives and procedures, so that the test results from the various industrial sources can be easily compared.

As for the test objectives of iron core materials, the following are considered as essential from the viewpoint of military applications: Toroidal permeability and losses, their respective temperature coefficients, their changes under storage at high and low temperatures, with or without the simultaneous influence of high relative humidity; furthermore the changes of volume resistivity,

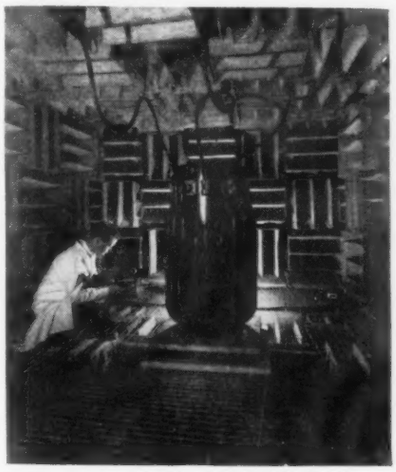
dielectric breakdown, mechanical properties, dimensions, and chemical nature of the material as caused by such exposure.

Once this information is in, we shall be in a much better position to judge the presently available materials and to determine to what extent they can be mutually substituted. From the accumulated data a list of acceptable materials could be prepared, which in due time might well become a military specification.

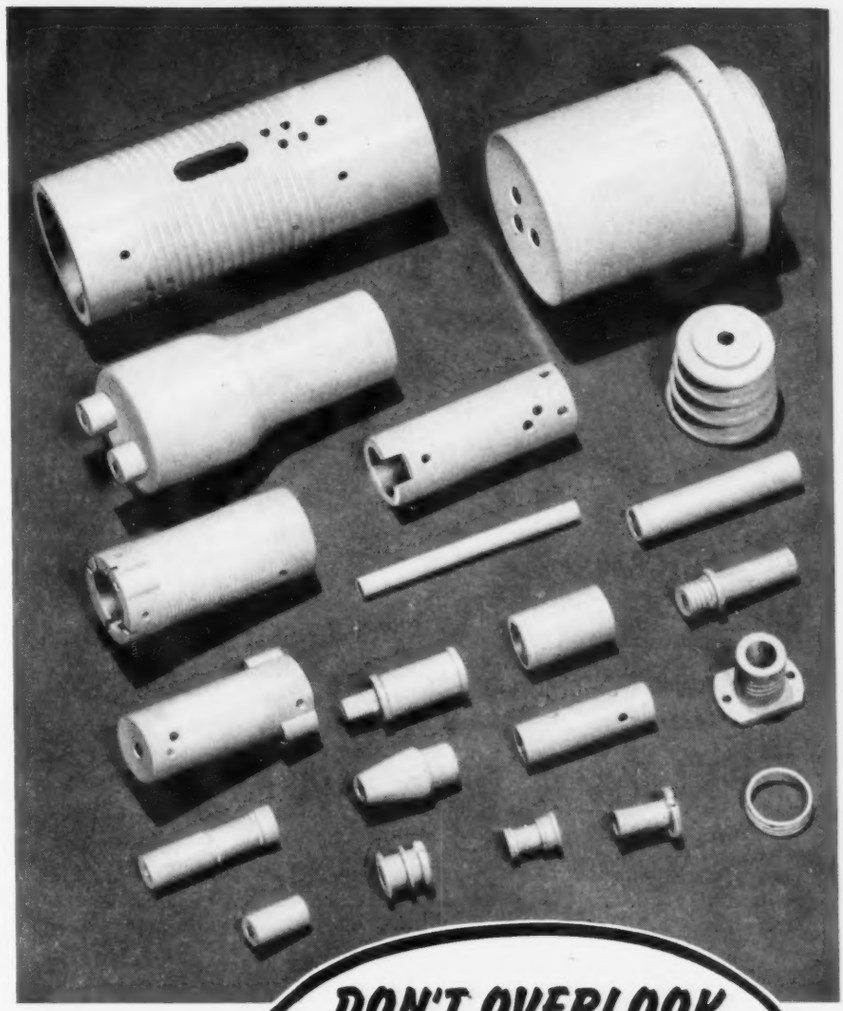
There can be no doubt that the core industry as a whole would derive great benefits from knowing their own product better. The necessity of meeting the stringent requirements dictated by the operating conditions of military communication equipment should therefore not only be considered as a challenge for the industry but also as an opportunity. In the interest of all concerned, it is to be hoped that the powder core manufacturers and their organization accept the challenge to appraise their present materials in the light of military requirements. The increased usefulness of improved materials will not only prepare the way for better and more dependable military communication equipment, but will also win new users and greater markets for the product of the powder core industry.

1. G. O. Altmann and H. Beller, **Electronic Industries**, Nov. 1945.
2. V. E. Legg and F. J. Given, **Bell Syst. Tech. Jour.**, July 1940.
3. **Antara Chemicals**—General Dyestuff Corp., vol. 1, no. 4, 1951, p. 21.

ANECHOIC TESTING CHAMBER



Surrounded by masonry walls 12 in. thick, a 19 x 13 x 10 ft. room in a Pittsburgh suburb serves Westinghouse as a sound measuring chamber. Anechoic effect is achieved by glass wool wedges, 8 x 24 in. at base and 34 in. long, which cover interior. Equipment is operated in low sound level (10 to 15 db) room and studied to reduce noise and set up measuring standards. It is estimated that Westinghouse spends $500,000/year for each db of sound diminution in its products



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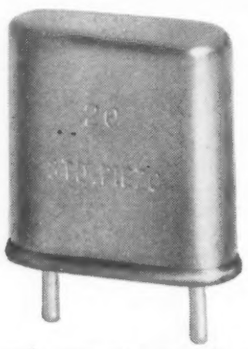

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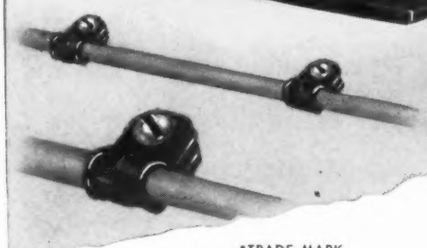

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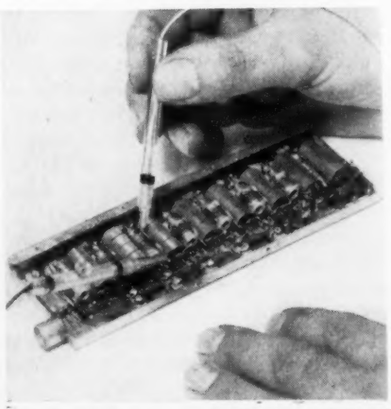
Uninterrupted Power

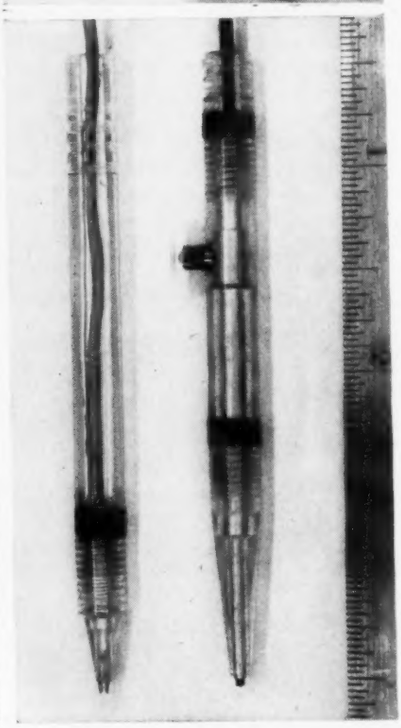
(*Continued from page* 39)

vert the dc from the ship's mains to ac. Switchover from normal to stand-by operation is usually manual.

Recognizing the need for uninterrupted power for microwave relay systems and other vital communications apparatus, the engineers of the Bogue Railway Equipment Div. have developed a series of continu-

NEW MINIATURE TEST PROBES





Two new test probes for use with miniaturized electronic equipment have been developed at the National Bureau of Standards. One probe, a push-on type, has a silver-plated beryllium copper jaw which protrudes 1/16 in. from the lucite handle. The short protrusion minimizes the danger of shorting to nearby components. This type grips the wire on which it is pressed until pulled away. The other probe, a lock-on type, has a small hook in its tip which is controlled by a button on the side of the handle. This probe cannot be removed from the wire until the release button is pressed

ous power systems for this specific purpose. With the Bogue system, the communications equipment is not operated directly from the power mains. Instead, ac is provided by an alternator which is rotated by an ac motor. This motor receives electrical energy from the power mains. In effect, a rotating transformer is placed between the communications equipment and the primary power source.

In tandem with this ac-to-ac motor-generator set is a dc motor. The ac motor, alternator and dc motor are direct coupled to each other, and are mounted in line on a common base, as shown in Fig. 1. Under normal conditions, the ac motor drives the alternator. Under emergency conditions the dc motor drives the alternator.

Batteries are Stand-By Source

Stand-by electric power is furnished from a set of batteries charged by an auxiliary rectifier charger or by the dc motor operated as a generator. When the dc motor is used as a battery charging generator, it is automatically connected to serve as a motor under emergency conditions and automatically reconnected to serve as a generator under normal conditions.

Normally, the communications equipment receives its power from the alternator which is driven by the ac motor and which is powered from the power mains. When primary power fails, even for an instant, a relay causes dc to flow from the stand-by batteries to the dc motor. This motor automatically takes over as the prime mover of the alternator until primary power is restored. See Fig. 2.

Naturally, with this arrangement the duration of operation under emergency conditions is limited by the capacity of the stand-by batteries. When continuous operation is desired over periods of power failure running from several hours to many days, the batteries may be kept charged by an auxiliary combustion engine driven generator which can be started automatically at a predetermined time interval after primary power has failed.

In locations where utility electric power is not available, a similar system may be used to provide power. In this case, the ac motor is not required. Power for the communications equipment would be supplied by the alternator normally driven by a dc motor receiving power from the engine driven generator across whose output is

(*Continued on page* 109)

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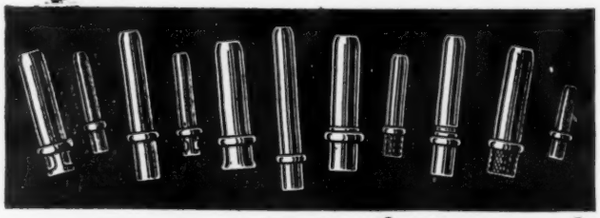

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floated a stand-by battery. Failure of the engine generator would put the burden of supplying power on the batteries until a stand-by engine generator starts operating.

In remote areas, the available electric power may have poor regulation and waveform. Voltage regulation better than ±0.5% may be provided automatically by magnetic amplifier type regulators. Where ±2% is satisfactory, carbon pile regulators may be used. In both instances, the tolerance in regulation is based on no load to full load. Under emergency conditions where the dc motor is the prime mover, or at locations where external power is not available and the dc motor is used to drive the alternator, ±0.1% frequency regulation may be provided by utilizing magnetic amplifiers for automatic control of the motor speed.

Power in U. S.

Power generally available in the U.S. is at 60 cycles, with 25 and 50 cycle power in some areas. Practically all commercial communications equipment is designed for operation at 60 cycles and the power supply systems described above referred to 60 cycle systems. The use of rotating electrical equipment for providing continuous power opens another point for consideration, 400 cycle power. Airborne radio and electronic equipment is generally designed for operation from a dc or high frequency ac source, in the general vicinity of 400 cycles. The use of high frequency power permits utilizing smaller and lighter transformers and filters.

Therefore, when new communications equipment is designed and the use of continuous power equipment is contemplated, it would be reasonable to consider 400 cycle power to take advantage of lower cost and simpler supply components as well as easier filtering. Primary power at 60 cycles could be fed to the ac motor with the alternator providing 400 cycle power for the communications equipment. Under emergency conditions, dc would provide the power for the motor.

At remote microwave repeater locations, single phase 60 cycle power at 120 or 240 volts is generally available, limiting the amount of available power to a few kw. Where greater power is required, three-phase ac should be provided for operation of the motor.

Through the use of continuous running motor-generator sets as described above, power interruptions can be eliminated.

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"300"
Broadcast
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● **Model "300" Broadcast** is specially designed to meet the exacting requirements of TV, radio broadcasting, and recording. It has a special "Grayje" subdued, non-reflecting finish that blends into the background, gives the spotlight to the performer. Has a "Voice-Music" switch for perfect reproduction of the soloist working at close range, or for the distant instruments of the orchestra. Special vibration-isolation unit eliminates "handling" noises and the pickup of floor vibrations. **Model "315" General Purpose** is similar in size, design and technical features to the Model "300." It is finished in rich, soft chrome—ideal for those public address applications where its streamlined design and beauty lend prestige to any setting in which it is used.

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L—35-50 ohms	58.7 db below 1 Milliwatt per 10 microbar signal
M—150-250 ohms	59.5 db below 1 Milliwatt per 10 microbar signal
H—High	57.0 db below 1 volt per microbar

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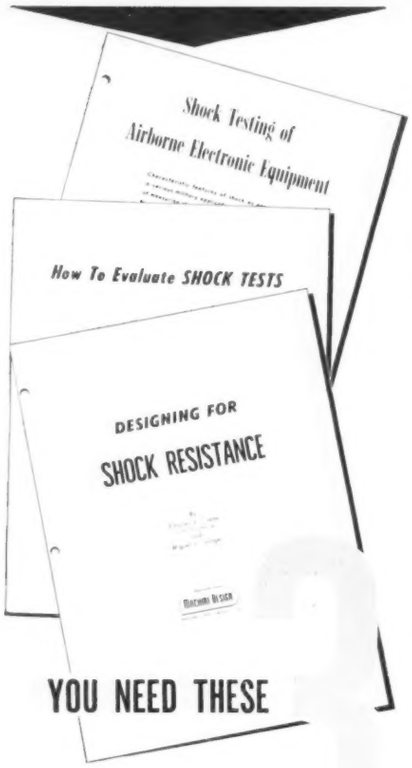

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Microphone Directivity

(*Continued from page 59*)

reverberation, fall upon the microphone from all directions at random, but with the same average intensity as before. What is the power output due to the undesired sounds? In the case of the omnidirectional microphone, which is equally sensitive in all directions, the output due to the noise is the same as that due to the desired sounds. Therefore, the Directivity Factor is unity. This is precisely why omnidirectional microphones are useful in the measurement of ambient noise.

In the case of directional microphones with directivity patterns of the Limaçon family, normal incidence power must be integrated about a sphere enclosing the microphone. The Directivity Factor is the reciprocal of this integral.

A useful corollary of the Directivity Factor is a deduction of the distance from the performer to the microphone for equal signal-to-random noise ratio. This is called a Distance Factor. The sound energy density roughly varies inversely with the square of the distance from the mouth of the performer. Therefore, the Distance Factor is the square root of the Directivity Factor. Both factors for the Limaçon family are given in Fig. 4 in terms of k, the quotient of the maximum phase shift angle due to the external gradient divided by the maximum total phase shift angle. It is seen that for equal signal-to-noise ratio, microphones having directional characteristics from cardioid to gradient may be used at distances from the performer between 73% and 100% greater than is possible with the omnidirectional microphones. Formerly, the Distance Factor was considered to have a bearing principally upon the freedom of motion of the performer in front of the microphone. It is now known, however, that this factor has an important bearing upon the unobtrusiveness of microphones.

To examine the problem of microphone unobtrusiveness, consider the following query: Will a 1-in. diameter microphone placed at 1 ft. from the performer partially hide his face for a greater portion of the audience than a 2-in. microphone placed at 2 ft.? The geometry of this situation is shown in Fig. 5. The large circle represents the head, and the small circle, the microphone. It is evident that all persons in the audience located within the angle γ will see the microphone in front of

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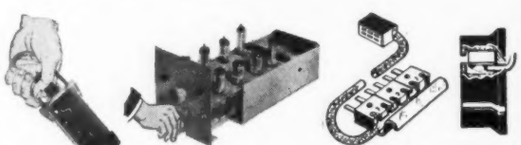

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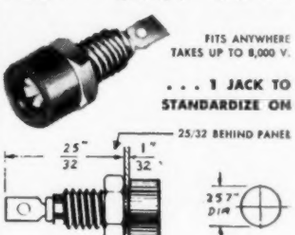

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ll or a portion of the face of the performer. This will not be the case for those outside the angle γ. The geometry of this situation is identical with that of a solar eclipse where γ is the angle of the penumbra. γ is given by the equation

$$\sin \gamma/2 = (a+b) / (a+b+2D),$$

D being the distance between the two bodies and a and b the diameters of the bodies. Assuming a head with average diameters of 7 in., families of curves have been drawn in Fig. 5 showing the angle of the penumbra as a function of distance for microphones of various diameters. These curves bring out interesting facts: An omnidirectional microphone with a diameter of 1 in. placed at 10 in. from the performer will partially obstruct the view of the audience seated within an included angle of 34°. If the microphone could be reduced down to nothing so that only the stand tubing were to remain, the view of a 30° segment of the audience still would be obstructed. However, if the same

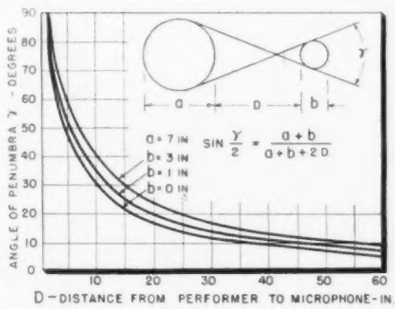

Fig. 5: Angle of microphone penumbra, where b is mike diameter and a is the performer's head

1-in. microphone, by virtue of being endowed with directional properties, could be moved out to a distance of 17 to 20 in. the view of only a 21° segment of the audience would be obstructed. A relatively large microphone of 3-in. diameter at the greater distance will impede the view of only a 25° segment of the audience, which is considerably less than will be caused by the small microphone placed at 10 in.

Similar results are obtained by repeating this analysis for various distances from the performer. It will be seen in every case that a small omnidirectional microphone obstructs the view of a greater segment of the audience than a considerably larger microphone with cardioid or cosine characteristics. Therefore, for minimum obtrusiveness, microphones which are *directional* as well as *small* are needed.

Summarizing, the trend toward miniaturization is definitely good. Miniature omnidirectional microphones are useful for noise measurement purposes. When small and light they can be easily worn on the lapel of the speaker. They are useful for round table discussions, for orchestral sound pickup and similar applications in relatively "dead" studios where it is desired to preserve all the available reverberation. Semidirectional microphones are valuable for general announce purposes, and commentary in sports and public events where it is desirable to create the general presence of the crowd, and yet to decrease some of the high frequency background noises. Directional microphones are indicated when it is desired greatly to reduce ambient noise, emphasize or de-emphasize certain instruments in an orchestra, control feedback in public address systems, reduce reverberation and hangover in live studios, and permit the performer to stand at a greater distance from the microphone. Unobtrusiveness of microphones is also improved by directional properties. The choice of pattern will depend upon the source and location of reflections and undesired sounds, as well as upon the experience and preference of the users.

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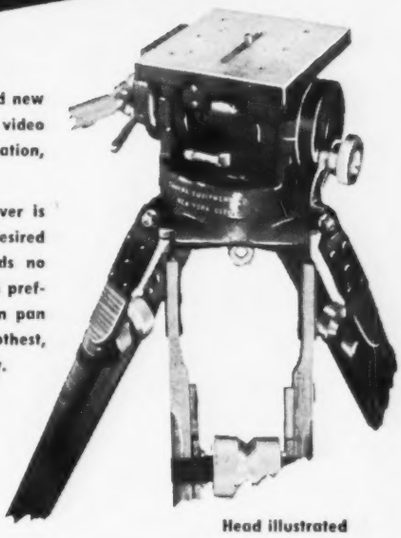

Head illustrated contains adjustable camera tie-down screw for locating center of gravity. This feature is optional.

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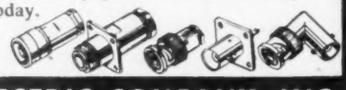


UALITY UANTITY UICKLY — DAGE

DAGE ELECTRIC COMPANY, INC.
67 North Second Street • Beech Grove, Indiana

Eidophor

(*Continued from page 57*)

(8). The larger the number of bars the greater is the number of raster elements in a horizontal line. The system should be capable of more than 1000 of these elements per line which meets all requirements for the time being. The possible number of horizontal sweep lines crossing the parallel light lines perpendicularly which may be included in a raster is almost unlimited, the system having operated satisfactorily at 392, 525, 625, and 729 lines.

Therefore, to project an image on the theatre screen, it is necessary that the output of a TV camera be fed to the electron gun to cause the electron beam to deform the Eidophor liquid in a proper manner which corresponds, element for element, to the original scene viewed. The fact that the liquid deformations retain the image from which the light is reflected caused the inventor to give it the name Eidophor, derived from Greek sources, meaning image bearer.

Eidophor Liquid

Examination of the criteria governing the Eidophor liquid indicates that the charges deposited thereon should cause the liquid deformations to remain for one picture period, but to decay rapidly after the period is over. The oil is made conductive to make the deposited charges decay according to an exponential time function. The storage time of the picture is controlled by selecting a liquid of proper conductivity, surface tension and viscosity.

The Eidophor liquid constantly carries an average negative charge which exerts a mechanical force on the liquid. If the liquid film were left to itself, it would eventually be pushed out of area (8). To prevent this, the spherical mirror (7) is slowly rotated to renew the image carrier. A radial knife edge (9) allows the passage of a quantity of the liquid, which has a consistency similar to honey, necessary for the production of the picture carrier.

The liquid and electron gun are placed in a vacuum. In order to keep the pressure to about 10^{-5} to 10^{-4} mm Hg, a continuously operating oil diffusion pump is mounted on the projector. A very low vapor pressure is a prime requirement for the liquid. Furthermore, it must be transparent to prevent any influence on the color of the picture. Since the deformations are dependent on the viscosity, which in turn depends on temperature, a refrigeration unit is

sed to assure constant temperature nd picture results. Most important, ecause the system is very sensitive o even the smallest inhomogeneities maximum liquid deformations are nly a few thousandths of an mm). ssembly must be accomplished ithout allowing any foreign parti- les to enter the optical system, par- icularly on the oil surface of the pherical mirror.

Unlike ordinary cathode ray ubes, which employ amplitude modulation, Eidophor uses a kind of elocity modulation. To produce the picture raster, 17-kv electrons from a tungsten cathode deposit a periodic distribution of charge along every picture line, the magnitude of this charge being proportional to the brightness of every picture point. The electrons are confined to a constant intensity beam of rectangular cross-section (width 10 to 20% of height), whose height is the width of one picture line. Since the beam intensity is constant at 70 μa, variations in charge density deposited on the Eidophor liquid are made by modulating the writing speed. That is, the greater the speed, the less charge deposited to deform the oil, and the less the light is deflected to pass through the mirror slits.

The modulation is produced by superimposing a constant frequency ac voltage on the line sweep voltage. Raster element dimensions are determined by the frequency of this superimposed voltage, while the density of the charge deposited is controlled by the amplitude. Modulation velocity potentials of the order of 1 volt are introduced through separate plates.

The results of a recent U. S. theatre demonstration of the projector indicates that one prime advantage of Eidophor is its ability to produce a high definition color picture of comfortable brilliance. In this showing, a 525-line raster and 8 mc bandwidth were used with the CBS field-sequential color system. The projected picture of the live studio pick-up was bright (about 40 lux in the highlights), had good contrast (1:200), and generally was of excellent quality, almost comparable with color motion pictures. It was noted that Eidophor is also adaptable to a simultaneous color system.

The fine results obtainable with the presently developed model appear to warrant early introduction into American theatres. Work is progressing to improve the projector and to develop an associated film system which will take advantage of several desirable qualities in motion pictures which are not realized in conventional filmed TV programs intended for home reception.

Larger Quarters for RMS

Radio Merchandise Sales has moved to a new location at 2016 Bronxdale Ave., New York 60, N. Y., the site of a former sports club. The modern structure provides 45,000 sq. ft. of space for the firm's electronic production.

TRANSISTOR PLANT OPENED

Dedicated with a simple ceremony, Raytheon's new plant at Waltham, Mass., will house most of the Research Division's $2,000,000 transistor program, as well as activities of the Equipment Div. Officiating were (l to r): N. B. Krim, v-p and mgr. of Receiving Tube Div.; N. B. Nichols, mgr. of Research Div.; Mayor H. A. Turner; President C. F. Adams, Jr.; and Dr. I. A. Getting, v-p of Engineering and Research

Just one advantage of the 2000-watt Century Featherlite is that it weighs only 9½ pounds—as against more than 35 pounds in other Fresnel spotlights of equal wattage

CENTURY LIGHTING, INC.,
521 WEST 43RD STREET,
NEW YORK 36

626 NORTH ROBERTSON
BOULEVARD,
LOS ANGELES 46

ORGAN AT CONVENTIONS

For the entertainment of effervescent delegates to the nominating conventions in Chicago, an electronic organ was installed by C. G. Conn, Ltd. The loudspeaker system was designed by Jensen Mfg. Co. It contained ten G-610 triaxial speakers in back-loading folded horns, plus four P15-LL woofers on two horns with 40 sq. ft. mouths to handle the 32-cycle notes. Only part of the 750-watt amplifier capacity was used

Metallized Capacitors

The self-healing characteristics of the metallized paper capacitors described by Pyramid Electric Co., N. Bergen, N.J., in their new Catalog MP-2, is derived from the 0.000003 in. deposited aluminum film which oxidizes, melts or vaporizes away from any conducting particle or flaw in the dielectric. When voltage is applied, the weak point is isolated from the rest of the winding. Thus, capacitors rated to 600 v. dc may use less insulation, resulting in marked size and weight reductions. Also available are general Catalog J-7, Catalog IMP-1 on molded tubular paper capacitors, and Catalog PG-1 describing hermetically sealed miniature paper types.

N.R.K. Opens Plant

N. R. K. Manufacturing & Engineering Co. has opened a new plant with new equipment at 4601 W. Addison St., Chicago 41, Ill. Facilities cover over 23,000 sq. ft., more than twice the area of the former plant. An additional 23,000 sq. ft. is also available for future expansion.

NOL Develops Special Alloy For Permanent Magnets

A new material from which the most permanent magnets can be made has been developed by E. Adams, W. Hubbard and A. Syeles of the Naval Ordnance Lab. It has the highest coercive force known (3,000 oersteds) and a powerful pull (3,000,000 gauss-oersteds) equal to the best materials available.

The new alloy, bismanol, consists of a mixture of two individually nonmagnetic elements, bismuth and manganese. It was developed as part of a program to find a fine-particle magnetic material not containing nickel or cobalt. One-cm. sq. pieces of the metal are presently being produced.

List of WESCON Exhibitors and Booth Numbers

See page 68 for Technical Paper Program

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif. 514
Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif. 307
Aerovox Corporation, 740 Belleville Ave., New Bedford, Mass. 314
Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa. 704
Airtron, Incorporated, 101 East Elizabeth Ave., Linden, N. J. 322
Alpha Wire Corporation, 430 Broadway, New York, N. Y. 326B
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif. 601, 602
American Electric Motors, Inc., 4811 Telegraph Rd., Los Angeles, Calif. 112
American Lava Corp., Cherokee Blvd. & Mfgrs. Rd., Chattanooga, Tenn. 506
American Microphone Co., 370 South Fair Oaks Ave., Pasadena, Calif. 1112
American Phenolic Corporation, 1830 South 54 Ave., Chicago, Ill. 404
Andrew Corporation, 363 East 75 Street, Chicago 19, Ill. 803
Arnold Engineering Company, The, P. O. Box G, Marengo, Ill. 1103
Assembly Products, Inc., Chagrin Falls 1, Ohio 1016
Audio Devices, Incorporated, 444 Madison Ave., New York, N. Y. 316
Audio Products Corporation, 2265 Westwood Blvd., Los Angeles, Calif. 1310
Automatic Electric Sales Corp., 1033 W. Van Buren St., Chicago, Ill. 421
Avery Adhesive Label Corp., 1616 S. California Ave., Monrovia, Calif. 1010
Ballantine Laboratories, Inc., Fanny Road, Boonton, N. J. 408
Bendix Aviation Corp., 401 N. Bendix Drive, South Bend 20, Ind. 802
Berkeley Scientific Corp., 2200 Wright Ave., Richmond, Calif. 201, 202
Beta Electronic Corporation, 333 East 103 St., New York, N. Y. 520A
Bird Electronic Corporation, 1800 E. 38 St., Cleveland, Ohio 1209
William Brand & Co., Inc., The, North & Valley Sts., Willimantic, Conn. 1317
Brown Electro-Measurement Corp., 4635 S. E. Hawthorne Blvd., Portland, Ore. 1109A
Brush Development Co., The, 3405 Perkins Ave., Cleveland, Ohio 218, 219
Burlington Instrument Company, 203 N. 3 St., Burlington, Iowa 309
Burton Electronic Mfg. Co., 2353 Cotner Ave., Los Angeles, Calif. 1015
Bussmann Manufacturing Co., University at Jefferson, St. Louis, Mo. 1105
Cambridge Thermionic Corp., 445 Concord Avenue, Cambridge, Mass. 520B
Cannon Electric Company, 3209 Humboldt St., Los Angeles, Calif. 207
Centralab, Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee, Wis. 424
Chicago Transformer Div., Essex Wire Corp., 3501 W. Addison St., Chicago, Ill. 416
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif. 603
Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif. 108
Clear Beam TV Antennas, 100 Prospect Ave., Burbank, Calif. 103
Cole Instrument Company, 1320 S. Grand Ave., Los Angeles, Calif. 1312
Collins Radio Co., Western Div., 2700 W. Olive St., Burbank, Calif. 1115
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif. 1402
Condor Radio Manufacturing Co., 116 N. Montezuma, Prescott, Ariz. 1401
Consolidated Eng'g. Corp., 300 N. Sierra Madre Villa, Pasadena, Calif. 1316
Cornell-Dubilier Elec. Corp., 333 Hamilton Blvd., S. Plainfield, N. J. 1307
Corning Glass Works, Corning, New York 1104
Dielectric Laboratories, Inc., 1275 Riverside Drive, Los Angeles, Calif. 317
Distillation Prod. Ind., Div. Eastman Kodak Co., 755 Ridge Rd. W., Rochester, N. Y. 502
Allen B. DuMont Labs., Inc., Cathode-Ray Tube Div., 750 Bloomfield Ave., Clifton, N. J. 805
Eitel-McCullough, Inc., 798 San Mateo Avenue, San Bruno, Calif. 1218
Electro-Cap, Inc., 1269 Riverside Drive, Los Angeles, Calif. 1107
Electro Engineering Works, 6021 College Ave., Oakland, Calif. 1116
Electronic Associates, Incorporated, Long Branch, N. J. 1204
Electronic Engineering Associates, 1040 Brittan Ave., San Carlos, Calif. 1106B
Electronic Eng'g. Co. of Calif., 180 S. Alvarado St., Los Angeles, Calif. 1315
Electronic Instrument Company, 84 Withers St., Brooklyn, N. Y. 311
Electro-Voice, Incorporated, Cecil & Carroll Sts., Buchanan, Mich. 804
Erie Resistor Corporation, 644 West 12 Street, Erie, Pa. 213
Fairchild Camera & Instr. Corp., 88-06 Van Wyck Blvd., Jamaica, N. Y. 1313, 1314
Filtron Sales Corp., The, 131-05 Fowler Ave., Flushing, L. I., N. Y. 1303A
Fusite Corporation, 6028 Fernview Avenue, Cincinnati, Ohio 1018
Garrard Sales Corporation, 164 Duane St., New York, N. Y. 522
General Ceramics & Steatite Corp., Plant 3, Keasby, N. J. 326A
General Elec. Co., Apparatus Dept., 1 River Rd., Schenectady, N. Y. 701
General Elec. Co., Electronics Div., Electronics Park, Syracuse, N. Y. 702
General Radio Company, 1000 N. Seward St., Los Angeles, Calif. 1403, 1404
Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles, Calif. 1210
Girard-Hopkins, 1000 40th Avenue, Oakland, Calif. 303
Robert M. Hadley Co., 707 East 61 St., Los Angeles, Calif. 208
Helipot Corporation, 916 Meridian Ave., S. Pasadena, Calif. 1302
Hermetic Seal Products Co., 29-37 S. 6 St., Newark, N. J. 418
Hewlett-Packard Company, 395 Page Mill Rd., Palo Alto, Calif. 1205, 1206
Hoffman Radio Corp., 6200 S. Avalon Blvd., Los Angeles, Calif. 301, 302
Hycor Company, Inc., 11423 Vanowen St., N. Hollywood, Calif. 412
Hytron Radio & Electronics Co., Div. of CBS, 76 Lafayette St., Salem, Mass. 1305
Indiana Steel Products Co., The, Valparaiso, Ind. 428
Industrial Dev't. Eng'g. Assoc., Inc., 55 N. New Jersey St., Indianapolis, Ind. 206
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif. 501
International Resistance Co., 401 N. Broad St., Philadelphia, Pa. 403
Jennings Radio Mfg. Co., 970 McLaughlin Ave., San Jose, Calif. 509
J. F. D. Manufacturing Co., 6101 16 Ave., Brooklyn, N. Y. 310
Kaar Engineering Co., 2995 Middlefield Rd., Palo Alto, Calif. 420
Kalbfell Labs, Inc., 1090 Morena Blvd., P.O. Box 1578, San Diego, Calif. 308
Karp Metal Products Co., Inc., 211 63 St., Brooklyn, N. Y. 423
James Knights Co., The, 101 E. Church St., Sandwich, Ill. 1304
Laboratory for Electronics, 43 Leon St., Boston, Mass. 215A
James B. Lansing Sound, Inc., 2439 Fletcher Dr., Los Angeles, Calif. 1110
Leach Relay Company, 5915 Avalon Blvd., Los Angeles, Calif. 508
Lenkurt Electric Co., Inc., 1105 County Rd., San Carlos, Calif. 422
Lynn Electronic Research Co., 228 W. Palm Ave., Burbank, Calif. 318
Don McGohan, Inc., 3700 W. Roosevelt Road, Chicago, Ill. 410
McIntosh Laboratory, Inc., 320 Water St., Binghamton, N. Y. 1111
Magna Electronics Company, 9810 Anza Blvd., Inglewood, Calif. 419
Magnecord Incorporated, 360 N. Michigan Ave., Chicago, Ill. 1113
P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind. 503
Marconi Instruments Ltd., 23-25 Beaver Street, New York, N. Y. 407
Marion Electrical Instr. Co., Stark Street Gate, Manchester, N. H. 1309
Master Mobile Mounts, Inc., P.O. Box 1817, Los Angeles, Calif. 102
Measurements Corporation, Boonton, New Jersey 1014
Merit Transformer Corp., 4427 N. Clark St., Chicago, Ill. 1217
Midwestern Geophysical Lab., 3401 S. Harvard St., Tulsa, Okla. 1102
Mosley Electronics, 2125 Lackland Road, Overland, Mo. 1002
Nat'l. Carbon Co., Div., Union Carbide & Carbon Corp., 22 Battery St., San Francisco, Cal. 1017
National Company, Inc., 61 Sherman St., Malden, Mass. 1215
Nat'l. Electric Products Corp., Ch. of Comm. Bldg., Pittsburgh, Pa. 319
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood, Calif. 306
J. M. Ney Company, The, 71 Elm Street, Hartford, Conn. 518
Oak Manufacturing Co., 1260 Clybourn Ave., Chicago, Ill. 703
Ohmite Manufacturing Co., 4835 W. Flournoy St., Chicago, Ill. 1216
M. V. Palmer, Inc., Electronics Div., 4002 Fruit Valley Rd., Vancouver, Wash. 1007
Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif. 111
Permoflux Corporation, 236 S. Verdugo Rd., Glendale, Calif. 507
Phaostron Company, 151 Pasadena Ave., S. Pasadena, Calif. 1006
Pioneer Electronics Corp., 2232 Broadway, Santa Monica, Calif. 1005
Polytechnic Research & Dev't. Co., Inc., 55 Johnson St., Brooklyn, N. Y. 425
Potter & Brumfield, Princeton, Indiana 205
Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y. 1101
Radio Receptor Co., Inc., 251 W. 19 St., New York, N. Y. 516
Raytheon Manufacturing Co., 55 Chapel St., Newton, Mass. 330
RCA Victor Div., Radio Corp. of Amer., Front & Cooper Sts., Camden, N. J. 904, 905
Reeves Instrument Corp., 215 E. 91 St., New York, N. Y. 1303B
Remler Company Ltd., 2101 Bryant St., San Francisco, Calif. 901
Raymond Rosen Eng'g. Prods., Inc., 32 & Walnut Sts., Philadelphia, Pa. 1409
Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif. 101
Sangamo Electric Co., 11 & Converse Ave., Springfield, Ill. 1203
Walter L. Schott Co., 3225 Exposition Pl., Los Angeles, Calif. 214
Scintilla Magneto Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y. 801
Sensitive Research Instr. Corp., 9-11 Elm Ave., Mt. Vernon, N. Y. 1410
Sequoia Products Corp., 894 Douglas Ave., Redwood City, Calif. 1001
Shure Brothers, Inc., 225 West Huron St., Chicago, Ill. 110
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif. 1106A
Simpson Electric Company, 5200 W. Kinzie St., Chicago, Ill. 304
Sola Electric Company, 4633 West 16 Street, Chicago, Ill. 411
Sorensen & Company, Inc., 375 Fairfield Ave., Stamford, Conn. 1207, 1208
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., Houston, Tex. 1011
Spencer-Kennedy Labs, Inc., 186 Massachusetts Ave., Cambridge, Mass. 321
Sperry Gyroscope Co., Div., Sperry Corp., Great Neck, N. Y. 305
Sprague Electric Company, North Adams, Mass. 401
Standard Transformer Corp., 3580 N. Elston Ave., Chicago, Ill. 1305
Superior Electric Co., The, 83 Laurel St., Bristol, Conn. 413
Surprenant Manufacturing Company, Clinton, Mass. 902, 903
Sylvania Electric Products Inc., 1740 Broadway, N. Y., N. Y. 1213, 1214
Tape Master Incorporated, 13 W. Hubbard St., Chicago, Ill. 1109B
Tartak-Stolle Electronics, Inc., 2970 S. Grand Ave., Los Angeles, Calif. 1311
Sarkes Tarzian, Inc., 539 S. Walnut St., Bloomington, Ind 329
Technology Instrument Corp., 531 Main St., Acton, Mass. 215B
Tektronix Incorporated, P.O. Box 831, Portland, Ore. 1407, 1408
Tetrad Co., Inc., 4921 Exposition Blvd., Los Angeles, Calif. 1117
Thermador Electrical Mfg. Co., 5119 District Blvd., Los Angeles, Calif. 320
Transformer Engineers, 161 E. California St., Pasadena, Calif. 513
Triad Transformer Mfg. Co., 2254 Sepulveda Blvd., Los Angeles, Calif. 1201
Trutone Electronic Eng'g. Co., 812 N. Highland Ave., Los Angeles, Calif. 1004
Tung-Sol Corporation, 8575 Washington Blvd., Culver City, Calif. 210
Ungar Electric Tools, Inc., 615 Ducommun St., Los Angeles, Calif. 402
U. S. Engineering Co., 521 Commercial St., Glendale, Calif. 212
Varian Associates, 900 Varian Street, San Carlos, Calif. 1211, 1212
Vector Electronic Co., 1101 Riverside Dr., Los Angeles, Calif. 1108
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City, N. Y. 504, 505
Walkirt Company, The, 5808 Marilyn Avenue, Culver City, Calif. 1003
Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago, Ill. 517
Western Lithograph Co., 600 E. Second St., Los Angeles, Calif. 325
Westinghouse Electric Corp., 410 Bush St., San Francisco, Calif. 426, 427
Xcelite Incorporated, 2-28 Bank Street, Orchard Park, N. Y. 523

PERSONAL

S. H. Van Wambeck has joined the Hammarlund Manufacturing Co. designers and producers of variable capacitors, all-wave receivers, and remote control equipment, as chief engineer. He was previously director of research and engineering for Knapp-Monarch Co., St. Louis, and director of a U.S. Army Signal Corps project, making studies of special types of radio receiving equipment.

Dr. William G. Tuller, formerly Director of Engineering, has been elected Vice President in charge of Engineering of Melpar, Inc., Alexandria, Va., subsidiary of the Westinghouse Air Brake Co. Dr. Tuller is a senior member of the Institute of Radio Engineers; and a member of the Standards Committee, chairman of the Technical Committee on Information Theory and Modulation Systems, chairman of the sub-panel on Packaged Subassemblies of the Research and Development Board for the Armed Forces.

Edward Stanko, veteran RCA engineer and pioneer in radio and television in the 1920s, has been appointed to the newly created post of manager of engineering, technical products division, RCA Service Co. Inc.

Leo Beiser has been appointed assistant chief television engineer of CBS-Columbia, Inc.

M. M. Elliott has been appointed general manager of Motorola Canada Ltd., Toronto, Canadian subsidiary of Motorola Inc., Chicago.

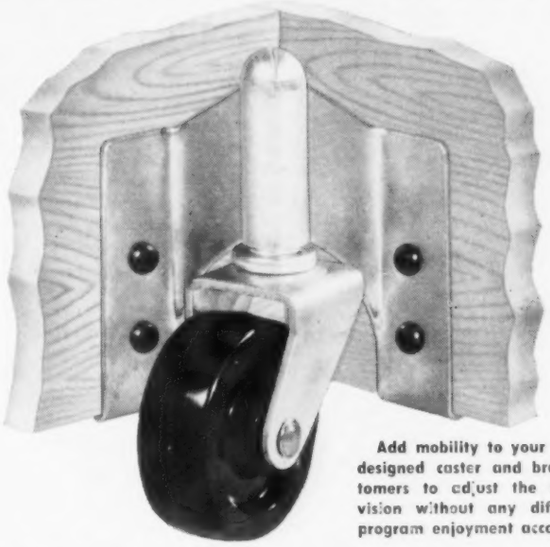
Dr. Ben Kievit has been named manager of sales engineering for the Radio and Television Picture Tube Divisions of Sylvania Electric Products Inc.

Anthony Clemento has been named director of purchasing of Raypar, Inc., 7800 W. Addison St., Chicago 34, Ill.

Recruiting Film Available

A new colored motion picture for training and recruiting engineers has been produced by RCA, and is available with projection equipment to interested groups. The 20-minute film, "Your Gateway to New Opportunities," contains many instructional shots of the inside of the radio-TV industry. Requests should be addressed to Mr. R. E. McQuiston, Mgr., Specialized Employment Div., RCA, 30 Rockefeller Plaza, New York 20, N.Y.

NOW! .. A CASTER
ESPECIALLY DESIGNED for TV CABINETS!



An Added Feature That Will Help Sell YOUR TV Sets

Add mobility to your TV cabinets with this especially designed caster and bracket. It will enable your customers to adjust the angle of their sets for better vision without any difficulty and will increase their program enjoyment accordingly.

Write for COMPLETE DETAILS

The Nagel-Chase bracket can be simply attached to practically any cabinet and permits application of casters without additional costly wood construction needed for the ordinary caster socket. The Nagel-Chase caster swivels freely because it bears on the point of the stem instead of the shoulders as ordinary casters do.

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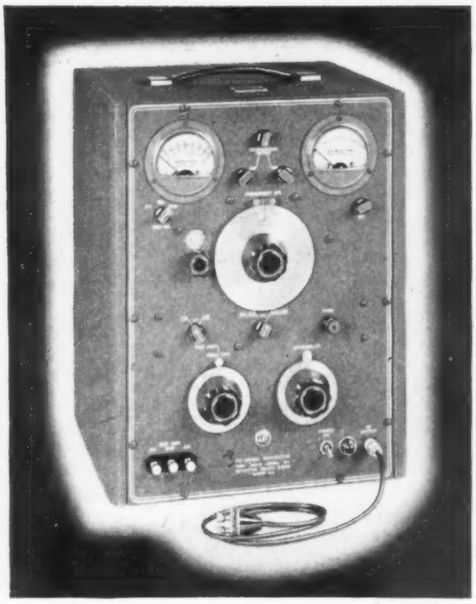
Our 25th Year

SUPREME, INC. **GREENWOOD 3M, MISSISSIPPI**



FM-AM SIGNAL GENERATOR

TYPE 202-B

54-216 Megacycles

Specifications:

RF RANGES: 54-108, 108-216 mc. ±0.5% accuracy. Also covers 0.4 mc. to 25 mc. with accessory 203-B Univerter.

VERNIER DIAL: 24:1 gear ratio with main frequency dial.

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AMPLITUDE MODULATION: Continuously variable 0-50%, calibrated at 30% and 50% points.

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RF OUTPUT VOLTAGE: 0.2 volt to 0.1 microvolt. Output impedance 26.5 ohms.

FM DISTORTION: Less than 2% at 75 kc. deviation.

SPURIOUS RF OUTPUT: All spurious RF voltages 30 db or more below fundamental.

AVAILABLE AS AN ACCESSORY
is the 207-A Univerter, a unity gain frequency converter, which in combination with the 202-B instrument provides additional coverage of from 0.1 to 55 megacycles.

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DESIGNERS AND MANUFACTURERS OF THE Q METER • QX CHECKER FREQUENCY MODULATED SIGNAL GENERATOR BEAT FREQUENCY GENERATOR AND OTHER DIRECT READING INSTRUMENTS

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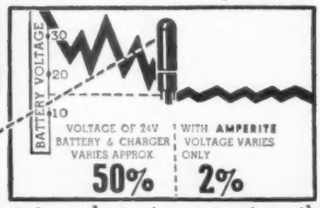
PROBLEM? Send for *"Special Problem Sheet"*

Regulators



Amperite REGULATORS are the simplest, lightest, cheapest, and most compact method of obtaining current or voltage regulation . . . For currents of .060 to 6 Amps. . . . Hermetically sealed; not affected by altitude, ambient temperature, humidity.

Write for 4-page Illustrated Bulletin.

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LETTERS . . .

"Subscription-TV" Second to Compatible Color

Editors, TELE-TECH:

Regarding Subscription TV as discussed on pages 33, 66 and 67 of your July issue, I am skeptical. I believe that the acute competition which will be brought about by the introduction of UHF Stations, will induce certain stations to concentrate on *quality* programs. There seems to be a tendency, even now, towards increasing the percentage of worth-while programs. Eventually the Telephone Company may be induced to give us high quality programs on a fee basis.

In my opinion, TV needs compatible color far more urgently than it does Subscription Programs. But more than anything else, TV needs moral reformation. H. I. Phillips, in his letter appearing in the July issue of TELE-TECH addressed to the Video and Radio Industries, states the situation facing the American home, today, in most penetrating terms. The criminal influence on the part of TV program smiths and their sponsors, their complete lack of moral responsibility to the American home, has become so flagrant that it is high time for our Congress to take definite and drastic steps to outlaw this continued degradation of this intrinsically noble triumph of radio engineering.

LEE DEFOREST

8190 Hollywood Bowl
Los Angeles 46, Calif.

Trans-Atlantic "Stratovision"

Editors, TELE-TECH:

Recalling our recent discussion on the inevitability of trans-oceanic TV and the possible application of "Stratovision" to this purpose, I have just had an opportunity to study the Westinghouse report on Stratovision made to the FCC, from which the following is abstracted:

Aircraft used should be designed for a cruising speed of 140 miles per hr.; high speed 250 mph; should fly at 30,000 ft., above all storms. Four planes should be provided for one link, arranged as follows: One in flight, handling the relay; one in flight in reserve; two on the ground or carrier for service and maintenance. Each plane would operate for 8 hours at a time. An airplane crew of 3 and a radio operations crew of 6 would be needed. The cost per airborn relay point would be about $1000 per hour.

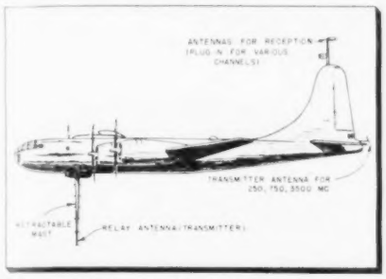
Distance between relay planes would be 350 to 400 miles with a ground (or water)-based relay station halfway in between. No comparative data on efficiencies of various frequencies could be found but Westinghouse report suggests for relay purposes 2,000 MC or higher frequencies, indicating that at 2,000 MC, 1 KW of power is needed.

Assuming a great-circle distance

from New York City to London of 2,500 miles, about 6 air relay stations and 6 water or ground-based stations will be needed. The plane nearest the originating terminal will have to be not over 70 miles from the originating station. If two of the relay points are ground-based then four aircraft carriers will be required.

Different TV Standards

The standards in Britain and France differ of course, from those in U.S.A. If the pictures from New York were televised exclusively for broadcasting in Britain then the standards at the camera and transmitting station could


ANTENNAS FOR RECEPTION (PLUG-IN FOR VARIOUS CHANNELS)
TRANSMITTER ANTENNA FOR 250, 750, 3500 MC
RETRACTABLE MAST
RELAY ANTENNA (TRANSMITTER)

Converted B29 used by Westinghouse-Glenn Martin

be shifted to the British standards. The same is true with the French standards. What the standards are in Russia is not known. It is believed that 525-line U.S. standard pictures, relayed to a foreign country, could be stripped of their characteristic sync information, leaving only the desired video information. This could be used, mixed with the local standard sync to form the correct composite signal to operate the local receivers. Actually neither the French nor the English standards are so far from the U.S., in fact some receivers, "flexibly" designed have controls that permit reception without conversion, with the possible exception of means for changing a positive picture into a negative picture. Committees of American engineers have tried to get foreign countries to select TV systems that would make the international interchange of TV material possible with the least of technical complications. Once a TV-relay system were set up, then there would be much more willingness of others to fall into line.

Local Transmitters Needed

For satisfactory broadcasting of TV in foreign countries it is desirable to use one of the latter's regular local TV transmitters because of frequency, power, etc. To force our programs into an unfriendly nation from, say, planes overhead or ships in coastal waters, would be very difficult because of competition from land-based TV transmitters and because TV is easy to "jam."

The aircraft carriers, used as landing stages for the planes and as relay stations, could also function as Weather Stations and Rescue Bases for com-

(*Continued on page* 118)

is your small parts problem here ?

ACTUAL SIZE
THE CASE OF THE DIFFICULT ASSEMBLY
Mounting plates for variable controls widely used in electronic equipment were originally two-piece assemblies of brass screw machine parts and steel stampings. Gries die cast the complicated part in one simple piece for easy assembly at a big saving. GRIES zinc alloy parts can do a better job for you, too! Exclusive facilities produce simple or intricate tiny parts in one automatic operation . . . completely trimmed, ready for use . . . 100,000 parts to many millions.

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SMALLNESS UNLIMITED
Max. Wt. ½ oz.
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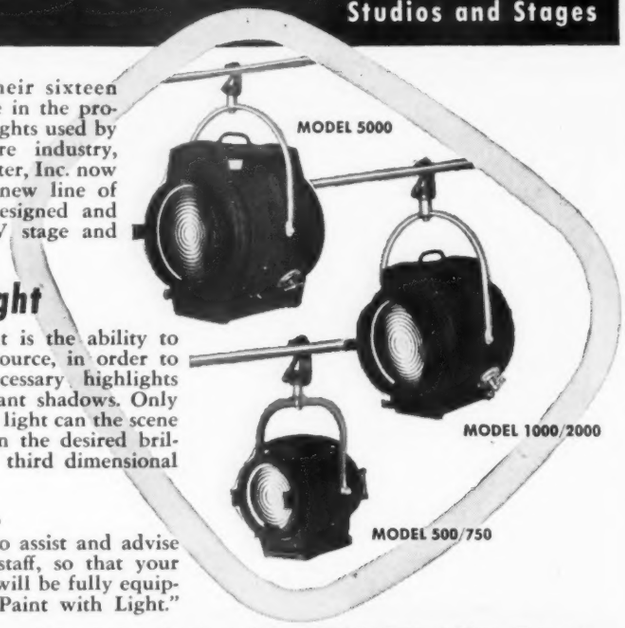
Drawing upon their sixteen years of experience in the production of studio lights used by the motion picture industry, Bardwell & McAlister, Inc. now offers a complete new line of lights especially designed and engineered for TV stage and studio lighting.



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"just like being there"

This new recorder incorporates advances in dependability and performance found in no other tape recorder: direct drive, positive disc brakes, simple threading, push-button control.

Relay rack panel mounted (illustrated), in console cabinet or in portable cases, this dependable recorder meets every requirement of broadcast studios. WRITE FOR BROCHURE NWR-1.

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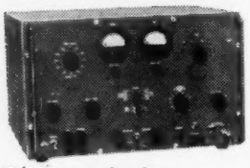
TYPE H-14

108-132 Megacycles
24 omni courses
Left-center-right phase localizer
Left-center-right 90/150 cps localizer



Signal source for bench or ramp testing of VHF airborne omnirange and localizer receivers. RF output for ramp checks, 1 volt into 52 ohms; for bench checks, 0-10,000 microvolts.

Price $885.00 net, f.o.b. Boonton, N.J.

TYPE H-12 900-2100 mc. RF signal source, CW or pulse amplitude-modulated. Equal to military TS-419/U.

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WRITE FOR DETAILS AND SPECIFICATIONS

AIRCRAFT RADIO CORPORATION
Boonton New Jersey
Dependable Electronic Equipment Since 1928

mercial airliners if forced down at sea.

At a time prior to 1930, Baird in England claimed to have transmitted a television image across the Atlantic. The signals from his relatively low-power experimental station, on a frequency between the upper limit of our aural broadcast band and the lowest frequency now used for TV, were reported to have been received on Long Island and to have produced a hazy picture on the scanning disc equipment used.

Actually, of course, there is a method already available today which will accomplish about 80% of the desired effect of a TV relay between USA and foreign countries. It is one that is not bothered by variations in standards, it is relatively cheap, and it is reliable. What is it? The transmission by commercial airplane of a film of the desired subject matter. This can be on the air in the foreign country within 20 hours.

PRACTICAL

Washington, D.C.

FCC Operating Requirements

Editors, TELE-TECH (telegram)

PLEASE SOUND THE ALARM. AN INFAMOUS ATTACK IS BEING MADE BY NARTB AND FCC ON ALL AMERICAN RADIO OPERATORS HOLDING RADIO-TELEPHONE, FIRST CLASS LICENSES. THERE ARE THOUSANDS OF MEN WHO HAD TO LEAVE THE BROADCAST RADIO FIELD BECAUSE OF STARVATION WAGES, TO ENTER OTHER RELATED FIELDS. I APPEAL TO YOU TO INFORM THESE MEN OF WHAT IS HAPPENING AND ADVISE THEM THAT AUGUST 4 IS THE DEADLINE FOR COMMENTS TO THE FCC ON PROPOSALS TO REDUCE LICENSE REQUIREMENTS FOR AM-FM STATIONS UP TO 10 KW USING NON-DIRECTIONAL ANTENNAS, AND TO PERMIT REMOTE CONTROL OF TRANSMITTERS OF SUCH STATIONS.

WGNI
WILMINGTON, N. CAR.

ART MADELEY
CHIEF ENGINEER

High Voltage Dry-Disc Rectifiers

Individual selenium rectifier discs capable of 60-volt ratings can be mass produced by utilizing the manufacturing processes described in the Final Report, PB 106312, *Selenium Rectifiers, High Voltage, Plate,* which covers the results of a Signal Corps research project. Conventional discs made today are able to withstand 26 v. The higher voltage ratings are achieved by a new technique for multiple layer build-up. Also described are various selenium coating methods and testing procedures. The 73 page report may be obtained from the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D.C. Check or money order for $10 (for photostat form) or $3.50 (for microfilm form) should be made payable to the Librarian of Congress.

"Wescon"

(*Continued from page 68*)

"Patents and the Engineer"—D. K. Lippincott, Lippincott & Smith
"Keeping Apace of Rapidly Changing Techniques"—R. G. Canning
"Management of Engineering and Research"—H. M. Stearns, Varian Associates

FRIDAY, AUGUST 29

XIX—Antennas

"On Spherically Symmetric Lenses"—J. E. Eaton, Naval Research Laboratory, Queens College
"Optimum Design of Linear Arrays in the Presence of Random Errors"—D. Ashmean, Philco Corp.

XX—Circuit Theory

Panel Discussion—"Wide Band Amplifier Circuits"
"The Distributed Pair"—D. O. Pederson, Stanford University

XXI—Audio Amplifiers

"Binaural Tape Recording"—J. S. Boyer, Magnecord, Inc.
"Analysis of A Single-Ended Push-Pull Audio Amplifier"—Dr. Chai Yeh

XXII—Data Handling

"The Sadic, A Precision Analog-Digital Converter"—R. L. Sink and G. M. Slocomb, Consolidated Engineering Corp.
"ERA Shaft-Position Analog-to-Digital Converter"—G. W. Lund, Engineering Research Associates, Inc.
"A Position Data Measuring System"—A. F. Bowen, U. S. Navy Electronics Laboratory
"A Teledeltos Outscriber"—W. Ware, Rand Corporation
"Flying Typewriter"—J. J. Wild, Potter Instrument Co.
"Synthesis of Transfer Functions with Poles Restricted to the Negative Real Axis"—Louis Weinberg

XXIII—Antennas and Propagation

"Modes in Waveguides Containing Ferrites"—M. L. Kales, Naval Research Laboratory
"Symmetrical Waveguide Junctions"—B. Auld and E. T. Jaynes, Stanford University
"Nodal Shift Impedance Measurements in Periodic Waveguide"—E. T. Jaynes, Stanford Univer.

XXV—Audio Amplifier

"High Intensity Microphones for Measurement of Shock Wave and Jet Engine Testing"—J. K. Hilliard, Altec Lansing Corporation

XXVI—Data Handling

"A Complete Telemetry System for the Flight Testing of Aircraft"—F. E. Bryan, Douglas Aircraft Co.
"A System for Recording Hughes Telemetering Data in Digital Form"—D. J. Simmons, U. S. Naval Ordnance Test Station
"Multi-Channel FM/FM Telemeter Data Handling System"—C. P. Ballard, Convair
"High Speed Printing Equipment"—L. Rosen, Analex Corporation

---

18 New Television Stations Authorized

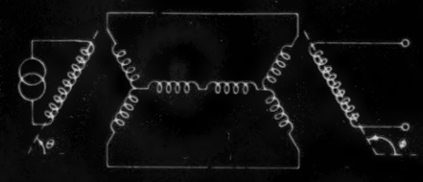
Eighteen new commercial television stations were authorized on July 11 by the FCC to serve 11 communities which had been without local TV service. They are the first such grants since the "freeze" was lifted.

New stations authorized in Group A-2 (cities without TV stations): **Denver, Colo.**—Eugene P. O'Fallon, Inc., Ch. 2; Colorado TV Corp., Ch. 9; Empire Coil Co., Inc., Ch. 26. **Portland, Ore.**—Empire Coil Co., Ch. 27; **Springfield-Holyoke, Mass.**—Hampden-Hampshire Corp. Ch. 55; Springfield TV Broadcasting Corp., Ch. 61; **Youngstown, Ohio**—Vindicator Printing Co., Ch. 73; WKBN Broadcasting Corp., Ch. 27; **Flint, Mich.**—Trans-American TV Corp., Ch. 28;

New stations authorized in Group B-1 (cities where UHF channels only are assigned): **Bridgeport, Conn.**—Southern Conn. and L. I. TV Co., Inc., Ch. 43; **New Britain, Conn.**—The New Britain Broadcasting Co., Ch. 30; **New Bedford, Mass.**—E. Anthony & Sons Inc., Ch. 28; **York, Pa.**—The Helm Coal Co., Ch. 49; Susquehanna Broadcasting Co., Ch. 43.

At a special evening session, 4 additional grants were made, two channels each in Spokane, Wash., and Austin, Texas.

KINETIX *Means*



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Rapid and accurate test of
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components under load conditions.

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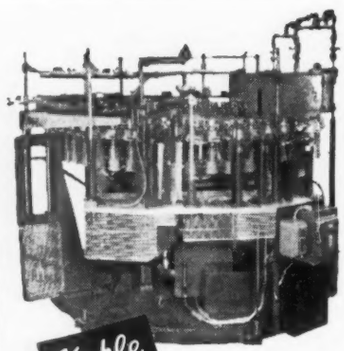

#1463 48-POSITION EXHAUST MACHINE for MINIATURE TUBES
All degrees of operation from manual to completely automatic. Production limited only by pump equipment or loading speed of operator.

Machinery for all types of electron tubes and related glass products.

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MILITARY CONTRACT AWARDS

Manufacturers who have received contract awards for producing of radio-radar-electronic equipment for the Armed Services are listed below by name, city and equipment. Subcontractors interested in bidding on performance of any part of each contract should sell their services to these prime contractors. This list, which is current up to our press time, covers the period from June 11 to July 2.

Aeronautical instrument spare parts: Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., $70,109

Accumulator for P2V-4: Vickers, Inc., Div. of Sperry Corp., 1400 Oakman Blvd., Detroit, Mich., $108,927

Altimeters: Radio Corp. of America, RCA Victor Div., Front & Cooper Sts., Camden, N. J., $66,857

Amplifier equipment: Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., $77,377; Stratford Pen Corp., New York City

Antenna equipment: Phoenix Electronics, 50 Island St., Lawrence, Mass., $95,899; Vendo Co., 7400 E. 12th St., Kansas City, Mo., over $250,000

Cable Equipment: Avon Electrical Supplies, Jamaica, New York; Roflan Co., 38 Maple Ave., Everett, Mass. $47,430; Rome Cable Corp., Rome, N. Y., $1,273; Saratoga Plastics, Bellows Falls, Vermont; Crescent Insulated Wire & Cable Co., Trenton, N. J., $161,319

Circuit breaker: Kay Elec. Supply Co., 21 N. Arkansas Ave., Atlantic City, N. J., $33,179; Westinghouse Elec. Corp., 3001 Walnut St., Phila., Pa., $106,597

Coil assemblies: Scintilla Magneto Div., Bendix Aviation Corp., Sidney, N. Y., $44,372

Connectors: Electroline Co., c/o F. O. Hoyt Co., 1417 Sansom St., Phila., Pa., $61,481

Generators: General Elec. Co., 1405 Locust St., Phila., Pa., over $250,000

Indicators: The Lewis Engineering Co., Naugatuck, Conn., $29,142; Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J., over $250,000

Interphone amplifiers and parts: Video Corp. of America., N. Y. C., $94,240.88

Loudspeakers, pillow type: Telex, Inc., 1633 Eustis St., St. Paul, Minn., $44,016

Oscilloscopes: Allen B. DuMont Laboratories Inc., 1000 Main Ave., Clifton, N. J. $83,497

Public address sets: Herald Radio & Television Mfg. Co., Mt. Vernon, N. Y., $9,545.55

Radar sets: Radiomarine Corp. of Am., 75 Varick St., N. Y. C., over $250,000

Radiacmeters: Freed Radio Corp., 300 Hudson St., N. Y. C., over $250,000

Rectifiers: General Electric Company, Washington, D. C.; Jerkin Engrg. Corp., El Segundo, Calif.

Regulators: Alar Products, 1071 Power Ave., Cleveland, Ohio, $27,090; Pacific Airmotive Corp., 2940 North Hollywood Way, Burbank, Calif., $155,778; Westinghouse Elec. Corp., 3001 Walnut St., Phila., Pa., $28,983

Relay assemblies: Cline Electric Mfg. Co., 3405 W. 47th St., Chicago, Ill., $38,936; Philco Corp., C & Tioga Sts., Phila., Pa., $39,427

Solenoid assemblies: The Magnavox Co., Fort Wayne, Ind., $45,264

Sound reproducers: Herald Radio & Television Mfg. Co., Mt. Vernon, N. Y.

Tachometer indicators: General Electric Co., Schenectady, N. Y. $222,461

Teletypewriter sets: Kleinschmidt Labs., Inc., County Line Rd., Deerfield, Ill., over $250,000

Test equipment: Munston Mfg. & Service Co., Inc., Beech St., Islip, Long Island, N. Y., over $250,000

Theodolite, ML-247: David White Co., 315 West Court St., Milwaukee, Wis., over $250,000

Transformers: Westinghouse Electric Corp., Lima, Ohio, $30,855

Transmitter: American Machine & Metals Inc., U. S. Gauge Div., Sellersville, Pa., $106,225; Eclipse Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., $197,696

Tubes: Electronic Tube Corp., 1200 E Mermaid Lane, Phila., Pa., $35,250; Raytheon Mfg. Co., 55 Chapel St., Newton, Mass., $42,470; Sylvania Elec. Prods., Inc., 1740 Broadway, N. Y. C., $26,730; Westinghouse Elec. Corp., Merchandise Mart Plaza, Chicago, Ill., $50,730

Microwave Detector

(*Continued from page* 63)

the greatest number of electrons are present in the gas volume, it remains to determine the types of gases or gas mixtures and related factors such as electrode geometry and material to provide the most sensitive tube.

Fig. 6 represents one set of experimental results obtained by reading sensitivity as a function of gas pressure. Although this curve is for argon, which is not the best gas for detection purposes because of its propensity to sputtering, it does illustrate certain points.

It will be noticed that the sensitivity curve is definitely peaked with variation in pressure. It will be further noticed that this peak of sensitivity occurs at the minimum of the sparking voltage curve, commonly known as Paschen's Law curve. The latter result is to be expected since the Paschen's Law minimum represents the best conditions for production of electrons by the "avalanche" mechanism. An interesting byproduct is the minimum in the vswr at the same point, which is discussed below. The most sensitive point did not always occur at the Paschen's Law minimum, but it was generally true and pointed the way to further refinement. From the above it may be concluded that the gas or mixture giving the lowest sparking voltage would also yield the most sensitive tube.

Test Bulb Contents

The work of Druyvesten and Penning[1] showed that a mixture of neon and about 0.01% argon results in appreciably lower sparking voltages than any pure gas. The test bulb contains such a mixture of argon and enon, and quantitive tests with such a mixture resulted in the highest sensitivity of any gases used. For comparison, this sensitivity was approximately equal to that of the type 1N23A silicon crystal used as a monitor in these experiments. Signal-to-noise ratio for this gas mixture was approximately 75 db.

The Paschen's Law consideration likewise leads to the means of improving the tube sensitivity by variation of electrode geometry. As is well known, the use of parallel nonconcentric cylindrical electrodes such as the cylindrical tube above, yields a lower sparking voltage than a parallel plate tube at the same electrode separation (the rectangular tube above). By the same token the cylindrical tube would be ex-

(*Continued on page* 123)

Build YOUR OWN Heathkit TEST EQUIPMENT
Heathkit AUDIO GEN. KIT $34.50
Heathkit TUBE CHECKER KIT $29.50
Heathkit TELEVISION GENERATOR KIT $39.50
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Heathkits are completely engineered instruments supplied unassembled. Every kit goes together smoothly and easily. All drilling, punching, and painting has already been done for you.
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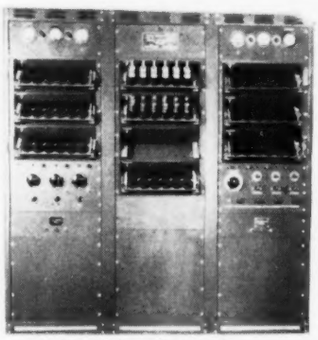

VACUUM TUBE LIFE TEST SET

MODEL TS-3

Designed for the life testing of vacuum tubes, including miniature and sub-miniature types, with either directly heated or indirectly heated filaments. All supply voltages are contained in the unit, are completely adjustable from 0 to rated maximum, and voltage regulated where required. Up to 120 tubes of 10 different types may be tested simultaneously for intermittent or continuous performance. Also available are removeable temperature ovens for life tests under controlled temperature conditions.

OUTSTANDING FEATURES INCLUDE

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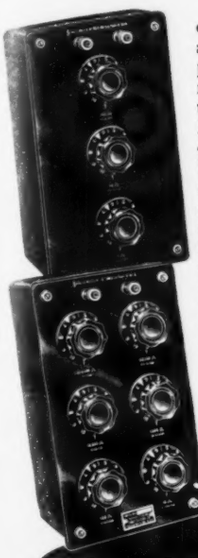
FOR FAST, ACCURATE TESTING



You'll find Shallcross Decade Resistance Boxes in use on production lines and in Military, Industrial, and School laboratories—wherever resistance must be varied in accurately-calibrated steps. Stock models are available with from 1 to 6 decades and with total resistances as low as 0.1 ohm or as high as 11.1111 megohms.

36 Standard resistance ranges

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Wheatstone Accuracy and Flexibility plus
PERCENT LIMIT BRIDGE CONVENIENCE

Here is a new Shallcross instrument for really *fast* and *accurate* (0.05%) GO, NO-GO comparative resistance measurements. The model 6320 Wheatstone Limit Bridge features a range of 0.1 ohm to 111.11 megohms adjustable in steps of 0.1 ohm and individual Plus and Minus percentage selectors covering 0.05% to 20% in 9 steps.

SHALLCROSS MANUFACTURING COMPANY
Collingdale, Penna.

pected to be a more sensitive detector than the "rectangular tube." This proved to be the case.

As a final refinement, the electrode material would be expected materially to affect the number of electrons because of secondary emission from the cathode by positive ion bombardment. Tests with the test bulb, whose electrodes were coated with oxides of barium and strontium, proved this to be true.

The best and most convenient of the possible positions for locating the cylindrical tube was with the electrodes extending across the broad dimension of the waveguide cross-section with the plane of the electrodes parallel to the direction of the electric field intensity vector. This was a fortunate result since by this means it makes little difference as to the particular modes of transmission through the waveguide. Regardless of the distribution of the intensities across the broad dimension, the electrodes were thus automatically covering the peaks.

The gaseous discharge is particularly rugged and not subject to burnouts, as is frequently the case with crystal detectors.

Other Applications

Referring to Fig. 6, the fact that the vswr varies with variation in pressure can be the basis for the design of an excellent attenuator. Another application of the gas tube detector is to use it as a modulator for microwave carriers. By this means it would appear possible to obtain various types of modulation of higher powered microwave oscillators than are presently available by means of the klystron tube.

The gaseous discharge tube makes an excellent microwave detector equal or better in sensitivity than the present crystal detector. It is rugged and its sensitivity may be varied by a number of means.

Consideration of factors influencing sensitivity will undoubtedly lead to other types of tubes of even greater sensitivity and improved signal-to-noise ratio.

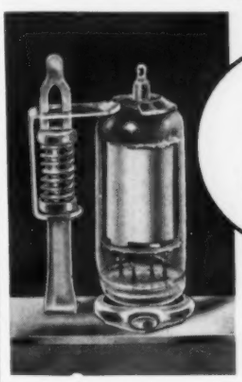
The gaseous discharge tube being of relatively large dimensions can be so positioned that it overcomes the location uncertainty mentioned under statement of the problem above.

This study of the properties of the gaseous discharge tube as a detector (and mixer) leads to further interesting applications as an attenuator and a modulator.

Rev. Mod. Phys., vol. 12 (1940), pp. 87-140.
This paper was first presented before the National Electronics Conference in Chicago, Ill., Oct. 22-24, 1951.

BIRTCHER
TUBE CLAMPS
Hold Tubes in Sockets under all Vibration, Impact and Climatic Conditions

83 VARIATIONS FOR STANDARD TUBES



NEW CLAMP FOR MINIATURE TUBES

You can't shake, pull or rotate a tube out of place when it's secured by a Birtcher Tube Clamp. The tube is there to stay. Made of Stainless Steel, the Birtcher Tube Clamp is impervious to wear and weather.

BIRTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

Millions of Birtcher Tube Clamps are in use in all parts of the world. They're recommended for all types of tubes: glass or metal—chassis or sub-chassis mounted.

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for September

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25th of second month preceding date of issue, for all ads requiring proofs, composition, foundry work, key changes, etc.

1st of preceding month for complete plates only—no setting.

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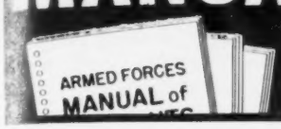

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News of MANUFACTURERS' REPS

Pyramid Electric Co., North Bergen, N. J., manufacturers of capacitors, has announced the addition of three new representatives to its list of national sales offices. Those named by the company were the Mike Roth Sales Co., Cleveland, Ohio; Merrill Franklin Co., Minneapolis, Minn,; and Theodore Lowell, of St. Louis, Mo.

DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. has announced the recent expansion of the Industrial Division with the appointment of the following new manufacturer's representatives: Irwin I. Aaron & Associates, Milwaukee, Wis., covering Wisconsin and Minnesota; R. C. Dudek, Beverly Hills, Calif., covering Southern California; William E. Burgoyne, Chicago, Ill., covering Illinois and Indiana; and E. L. Berman Co., San Francisco, Calif., covering Northern California. These new representatives will handle the complete DeJUR line of industrial products: precision potentiometers, panel instruments, plus the new Continental miniature precision connectors, terminal boards, and stand-off terminals.

Videon Electronic Corp., Indianapolis, Ind. has named three new sales representatives: Mike Roth, state of Ohio; R. W. Amos, states of Texas, Oklahoma, Arkansas and Louisiana; S. H. Stover, western Pennsylvania, state of West Virginia and Ashland, Ky.

Electronic Engineering Associates, Ltd., field application engineering company for Sierra Electronic Laboratories, San Carlos, Cal., has appointed The Kittleson Co., Los Angeles, to represent it in California and Arizona for its carrier-type screen gage amplifier, flush mounting pressure cell and other electronic items.

DX Radio Products Co., Chicago, Ill., makers of toroidal coils, deflection yokes, ion traps and other products, has appointed the John B. Tubergen Co., Los Angeles, to represent it in the Southern California Area.

New Headquarters for Camera Mart

Showrooms of Camera Mart, Inc., are now located at 1845 Broadway (60th St.), New York, N.Y. More than 4,000 sq. ft. of space are devoted to the display of professional motion picture and television studio equipment. The new line of Camart Products which is featured includes large and small camera dollies, mike booms, camera blimps, tripods, optical effects units and prisms. Mitchell 16mm and 35mm cameras and blimps, film editing machines, and Bodde background projection equipment are available for rental. A complete repair shop for camera and sound equipment is on the premises.

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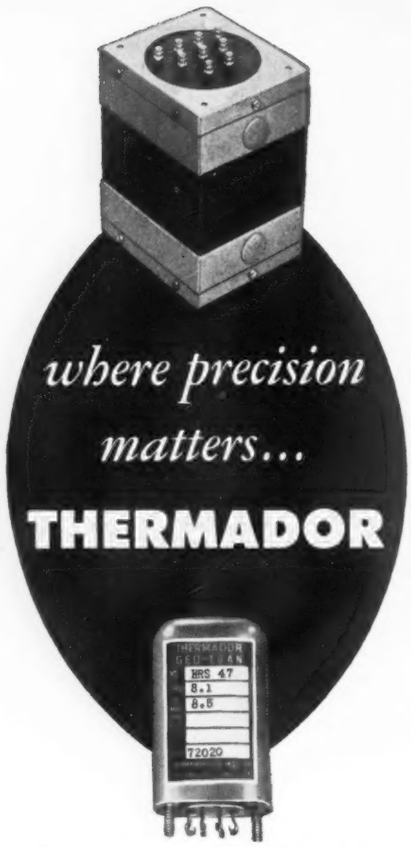

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BULLETINS

Forced Air Cooled Radiators

Red Arrow Electronics, Inc., 422 Alden St., Orange, N. J., has published a brochure on forced air-cooled radiators for power vacuum tubes. The construction of various types of radiators for cooling transmitting tubes for use as r-f amplifiers and oscillators and class B modulators and UHF power triodes of the ground grid type for service in TV and C W application are described.

Laminac Resins

American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y., has published a new technical data booklet entitled "Casting With Laminac Resins." Laminac Resins are liquids which solidify to clear, transparent solids, with or without the application of heat or pressure. They offer high moisture resistance, excellent insulation, resistance to chemicals and to dislocation of encased components. They also make possible easy and rapid production. Requests for copies should be made to Plastics and Resins Division.

Terminals

T. C. Wheaton Co., Millville, N. J., has announced that catalog No. W52 is now available. In addition to the specifications covering Wheaton's regular line of hermetic lead-thru terminals, and suggestions on how to use them, Wheaton's new glass trimmer capacitors are introduced. An insert covering the specifications on its new WR-8 relay is also included with the catalog.

Variable Resistor

Complete details on 167 types of military variable resistors available for immediate delivery from stock are given in stock sheet No. 162, just released by Chicago Telephone Supply Corp., Elkhart, Indiana. Included are JAN-R-94 and JAN-R-19 types and non-JAN controls. Six key controls are illustrated and dimensional drawings of five shaft types are given.

Capacitors

Capacitors specifications, construction, engineering data, sizes and prices are featured in four new bulletins published by the Pyramid Electric Company, 1445 Hudson Boulevard, North Bergen, N. J. Catalog PG-1 lists miniature Glasseal capacitor types PGH, PGM and PGX. These tubular paper units function perfectly at temperatures ranging from —55° to —125° C. Catalog IMP-1 describes Pyramid's newest line of molded plastic tubular capacitors. "IMPS" are known for their ruggedness, being impervious to moisture, and withstanding a temperature of 100° C. Catalog MP-2 gives detailed information on ultra-compact metallized paper types. Minimum size and weight and self-healing qualities are characteristic of these units. Catalog J-7 is a 32 page compilation of paper, electrolytic, oil-paper and metallized paper capacitors. Complete data on eighteen different types is listed.

Form & Core Fasteners

A variety of "Speed Nut" and "Speed Clip" fasteners, designed to save time and expense in the assembly of coil forms and tuning cores, is described in bulletin No. 326, issued by Tinnerman Products, Inc., Box 6688, Dept. 14, Cleveland, Ohio. Spring tension principle of fastening is employed. Fasteners are available for most existing varieties of coil forms and core assemblies and are adaptable to all types of material or thread systems.

Resistors

A comprehensive 64-page Vitrohm Resistor catalog has just been issued by the Ward Leonard Electric Co., Mount Vernon, N. Y. The new catalog (No. 15) fully illustrates and describes the company's complete line of Vitrohm power-type wire-wound resistors and an extensive variety of made-to-order units. Listed are seven distinct stock type units and an extensive variety of made-to-order types. Resistor ratings range from 5 to 550 watts while resistance values listed are from 0.04 ohm to 1.75 megohms.

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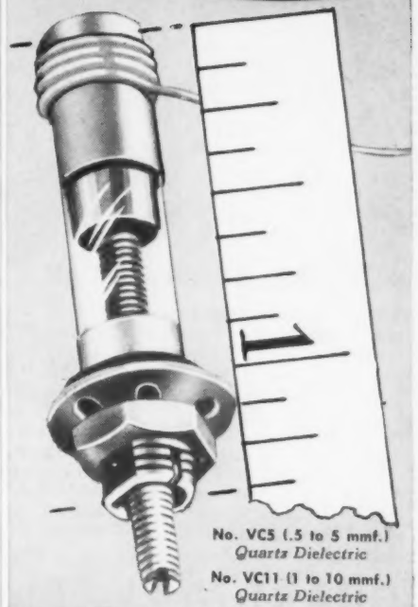

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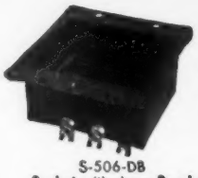
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